The Role of Information and Communication Technology Services within Small and Medium Enterprise as a Growth Factor Affecting Indonesia's Economy

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

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Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

Susanti Rachman

27/09/2017

To My Deceased Parents

Abdul Rachman and Endang Purnomowati

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In the name of Allah, the Most Gracious, the most Merciful.

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My praise to Allah, Lord of the worlds.

Abbreviations

ADF	Augmented Dickey-Fuller
ASEAN	Southeast Asian Nations
BPS	Biro Pusat Statistik (Central of the Statistical Bureau)
CAGR	Compound Average Growth Rate
GDP	Gross Domestic Product
ICT	Information and Communication Technology
ILO	International Labour Organisation
IMF	International Monetary Fund
IPS	Im, Pesaran and Shin
IaaS	Infrastructure as a Service
ITU	International Telecommunication Union
LLC	Levin, Lin & Chu
MCSME	Ministry of Cooperatives and Small & Medium Enterprises
OECD	Economic Cooperation and Development
PaaS	Platform as a Service
PC	Personal Computer
PP	Philips-Peron
SMEs	Small and Medium Enterprises
SOE	State Owned Enterprise
SaaS	Software as a Service
TAM	Technology Acceptance Model
TFP	Total Factor Productivity
TOE	Technology, Organisation, and Environment

Abstract

The relationship between Information and Communication Technology (ICT) services adoption by Small to Medium Enterprise (SME) and national economic growth is a key to understanding the potential for future ICT investment. In the literature, there is a gap in the body of knowledge relating to ICT investment by SMEs and productivity. Historical data sources relating to investment in technology as a generator of increased SME output are limited. The effects of the evolution, over the past decade, from in-house ICT delivery to outsourced ICT services should be studied to fully understand the changes that are taking place. Therefore, this study investigates the role of ICT services in accelerating SME output and how this impacts on the growth of the Indonesian economy. The research objectives include: 1) to understand how ICT services contribute to economic growth; 2) to investigate the impact of the ICT services used by SMEs on the Indonesian economy; 3) to identify ICT service contribution to SME gross output; and 4) to examine the significant factors influencing ICT services, specifically cloud computing, adoption by Indonesia's SMEs.

The existing literature on the implications of ICT for economic growth focuses on the use of in-house ICT to represent organisations technology level and as a general-purpose technology factor. Studies into ICT services use investment in telecommunications infrastructure or telecommunications density to be a proxy for ICT services capital. This research adopts ICT services usage, which includes fixed telephones, mobile telephones, the Internet and cloud computing, as a novel explanatory variable. Further, this research examines the role of ICT services using the Cobb-Douglass production function approach and the panel econometric technique. Primary data was gathered to provide the foundation for an analysis of ICT services on Indonesian SMEs. This analysis was complemented with a comparative study, using secondary data, of the role of ICT in developed and developing countries, to capture the

global ICT services trend. The secondary data covers 28 developed countries and 15 developing countries, over the period 1970 to 2013.

A field survey was carried out to collect the primary data from 399 SMEs in four cities in Indonesia from March to November 2015. A unique and comprehensive database was developed, based on the survey results, that covers SME respondents, demographics, ICT and ICT services used, cloud computing adoption, understanding of economic outlook, historical financial performance, and historical employee data, covering the period from 1998 to 2014.

Applying secondary and primary data analysis methods, this research obtained four key findings which address the research objectives. First, the secondary data analysis indicates that ICT services capital itself has a significant impact on output in the developed nations, but not in the developing countries. However, capital augmenting ICT services significantly increase a nation's economy both in developed and developing countries, as well as ICT infrastructure augmenting ICT services. For the Indonesian context, the empirical findings show similar results with the one found for the developed countries panel. Meanwhile, from the SME perspective the results show that SME total capital and labour contribute significantly to Indonesia's economic growth.

Second, the primary data analysis shows that the effect of capital, as the endogenous factor, and ICT services, as the exogenous factor, both make a significant and positive contribution to the output of Indonesian SMEs. The findings reveal that ICT services directly contribute to SME growth in the first year after implementation, with fixed and mobile telephones as the main contributor. Moreover, ICT services also work together either with total capital or labour capital to accelerate SME output. The findings also indicate that SMEs that are using landline Internet might be more productive. Taken together with the findings for the Indonesia context this research suggests that ICT services significantly influence SME output improvements and that this has a positive effect on the growth of the Indonesian economy.

Third, primary data was used to examine the ICT services adoption factors. This study combined two technology adoption frameworks, Technology Acceptance Model (TAM) and Technology, Organisation and Environment (TOE). An econometric technique, the probit choice model, was applied in this analysis. The results identify that management age, employee ICT skills, and organisational maturity and size were found to be a significant factor in influencing fixed telephone and Internet adoption by SMEs. Firms with middle-aged and younger management were found to be more likely to adopt fixed telephone and Internet, respectively. This research finding highlights contrasting employee ICT skills, organisational maturity and size when adopting fixed telephone and Internet. The adoption of broadband Internet connectivity was influenced by higher employee ICT skills, especially in new and small SMEs. For SMEs with employees that have lower ICT skills it was found that mature and large SMEs were more likely to adopt fixed telephone. Additionally, SMEs with the following attributes were more likely to utilise fixed telephone. SMEs with higher education levels, assembly based SMEs, SMEs located in Denpasar (the medium growth city), and SMEs who are aware of their competitors. On the other hand, SMEs located in Jakarta (the high growth city) were found to be less likely to adopt fixed telephone. The utilisation of other ICT services influenced the adoption of fixed telephone, mobile telephone and Internet services. Fixed telephone and mobile telephone were found to be opposing factors. SMEs that use fixed telephone were less likely to adopt mobile telephone, and vice versa. Nonetheless, the adoption of broadband Internet connectivity was affected by the utilisation of computers and cloud computing.

Fourth, employee characteristics determined the adoption of Cloud Computing by Indonesian SMEs more so than the management characteristics. SMEs with young employees were found to be more likely to adopt Cloud Computing than the SMEs with older employees. Employee ICT skills were a factor in this case due to the need for employees with ICT skills to utilise Cloud Computing. In terms of employee education, high school was found to be the most significant employee education level that affects whether a SME adopts Cloud Computing. The more mature SMEs are more likely to adopt Cloud Computing. This finding indicates that new SMEs are entering the market in a traditional way, they have not employed the benefits of Cloud Computing to help them grow faster. Cloud Computing is an important factor for SME innovation and R&D activity. Other ICT factors that support the adoption of Cloud Computing by SMEs are access to computers and the Internet. Therefore, it can be argued that SMEs still prefer to access Cloud Computing through personal computers and Internet connections rather than through mobile telephones.

To conclude, this research has contributed to the body of knowledge by introducing ICT services as a novel variable to investigate the contribution of ICT services as a growth enhancing factor for SME and the national economy. Additionally, the unique and comprehensive primary dataset about ICT services utilisation by SMEs provides an opportunity for further research. The research findings confirm that ICT services adoption by SMEs positively contributes to the growth of Indonesia's economy. This research outcomes provide information that might be used by governments, industry groups and the SMEs to gain a better understanding of how ICT services adoption by SMEs is a national productivity improvement factor. Finally, the research outcomes are expected to encourage the ICT service providers to target SME needs, to help the SMEs to better utilise ICT services, and to assist with policy and regulation development. The study has implications for other growing economies as well.

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Chapter 1 Introduction

1.1 Introduction

This study examines the impact of Information and Communication Technology (ICT) services on Small to Medium Enterprises (SMEs) in Indonesia and how this impact affects the growth of a national economy. The study incorporates the Cobb-Douglass Production Function approach and panel regression analysis to determine the significance of ICT services on SMEs and subsequently on national economic growth. To determine the factors that affect ICT services adoption by SMEs, this study combines two technology adoption frameworks: the Technology Acceptance Model (TAM); and the Technology, Organisation and Environment (TOE) Framework. The econometric technique used in this adoption analysis is the binary probit choice model.

Two research methods were used in this study including an analysis of primary data gathered through a field survey, conducted in four Indonesian cities, that covered a dataset of ICT services employed by 399 SMEs from 1998 to 2014 and a secondary data analysis of SME data from 28 developed countries and 15 developing countries from 1970 to 2013. The secondary analysis included Indonesian SMEs data from 2003 to 2013.

This chapter introduces the research, and is organised as follows. Section 1.2 provides the motivation, aims and research contributions. The study objectives and research questions are discussed in Section 1.3. Section 1.4 provides the research framework and Section 1.5 explains the research methodology. Section 1.6 provides a guide to the thesis organisation, and a summary of this chapter is set out in Section 1.7.

1.2 Research Motivation, Aim and Contribution

Indonesia is one of South East Asia's three Newly Industrialised Countries (NICs), the others being Malaysia and Thailand. It has 235 million consumers and its economy has grown by

16.5% from 2003 to 2013 (Sengupta, 2011; BPS, 2003-2013). The 57.9 million SMEs contributed 60.3 percent of Indonesia's total GDP in 2013. This figure represents an increase of 4.2 percent in 2013 from 2003. SMEs have become an important source of Indonesia's economic growth and employment. In 2013, 97 percent of Indonesia's private sector employment was accounted for by SMEs, growing from 96.3 percent in 2003 (BPS, 2003-2013). However, the average output per SME grew at a slower rate than what was achieved by large enterprises. The average annual output per SME grew only 14.2 percent with the annual output per large enterprise growing at 19.2 percent over the period 2003 to 2013 (BPS, 2003-2013).

Figure 1-1 Total SMEs and large enterprise contribution to Indonesia's GDP (2003-2013)

Source: BPS, 2003-2013

The Indonesian ICT service sector as the driver of the digital economy has grown rapidly in recent years. ITU (2016b) reports that Indonesia's individual internet users reached 25.4 percent of the total population in 2016. This figure grew at the average of 21.2 percent yearly over the periode 2003 to 2016. In 2016, the number of mobile telephone users is accounted for 385 million subscriber or 148.7 percent of the population. The CAGR of the mobile telephone users is 27.8 percent over the periode 2003 to 2016. However, three quarters of Indonesia's SMEs are missing out on most of the benefits of digital technologies. Delloite (2015) reports that in 2015, around one third (36%) of Indonesian SMEs are offline, another third (37%) have only basic online capabilities such as a computer or broadband access, and only a minority (18%) have what the report defines as intermediate engagement (use of websites and social media) or advanced engagement with e-commerce capabilities (9%).

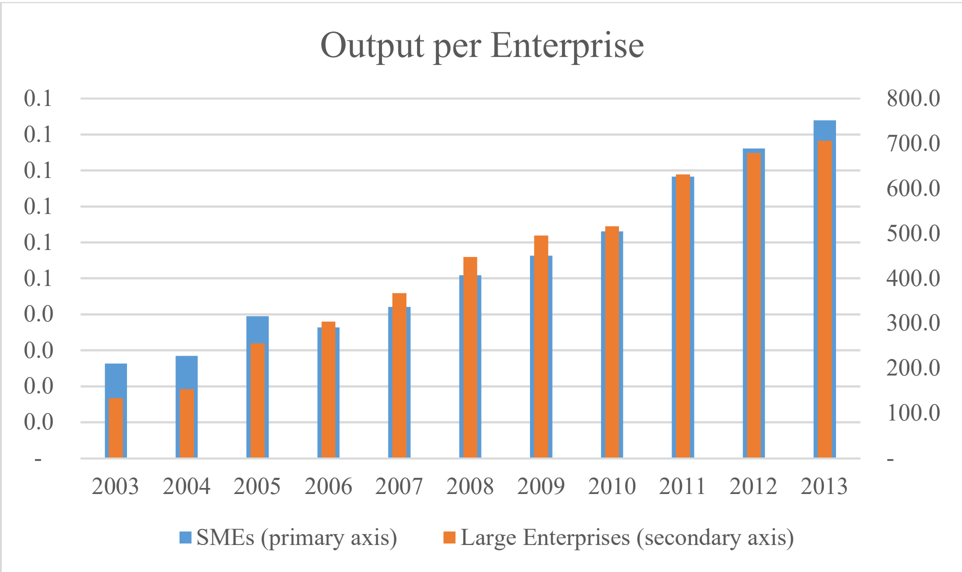

Figure 1-2 Trend of Total SMEs and large enterprise output (2003-2013)

Note: in billion IDR, Source: BPS, 2003-2013

ICT services adoption by SMEs is still very low with only 13.4% of SMEs using ICT services for production processes and 24% for marketing (MARS, 2013). This situation may work against the SMEs in the future especially when competing with large enterprises and global competitors, and any failure to compete successfully may slow Indonesia's economic growth. An investigation as to whether ICT services have played a role in SME growth in recent years presents an opportunity to build a new and innovative framework with attendant algorithms to describe ICT service growth and utilisation trends.

The focus of this research is to investigate the relationship between SME output and ICT services, and how increased knowledge of global ICT services and the digital economy can contribute to growing the Indonesian economy. The specific aims of this research are to:

1. Investigate the relationship between ICT services, SME output and national economic growth, using Indonesian empirical evidence;
2. Identify which ICT services can improve SME output to increase the contribution by SMEs to a national economy, using Indonesian empirical evidence;
3. Formulate recommendations about future and enhanced ICT services for SMEs to improve output and to contribute to national economic growth over a five-year study period.

The research rationale includes:

1. Indonesian SMEs contributed 60.3% of Indonesia's GDP in 2013, and have become an important impetus for economic growth; they were not affected by the global financial crisis in 2008, and remained the main source of employment (Mourougane, 2012);
2. ICT services have helped to increase large enterprise output by increasing productivity, competitiveness and by reducing costs and inefficiency (Harris et al., 2008). ICT services diffusion amongst SMEs is slow, and slower than that found in large enterprises (Santosa and Kusumawardani, 2010);
3. While the role of ICT in improving large enterprise's output is described extensively in the literature, it is still unknown whether ICT services can improve SME output to the same extent and have an increasingly positive effect on Indonesia's GDP.

This research will broadly contribute towards:

1. Explaining the role of ICT services to economic growth through improved SME output, and the relationship between ICT services capital with other growth variables: total capital and labour capital.
2. Providing SMEs with a better understanding of ICT service benefits to improve their output and explain how this can enhance opportunities to compete with large enterprises.
3. Encouraging ICT Service providers to focus on SME needs, and to build relationships with SMEs that will facilitate ICT service growth.
4. Assisting the Indonesian Government to develop broad policies and regulations that encourage SME output improvements through increased ICT service utilization.
5. Providing knowledge regarding the output relationship between SMEs and ICT Service utilization that can be adapted by other semi-industrialized countries.

The specific contributions of this research are as follows:

1. Showing the importance of ICT services in the development of an emerging economy, providing empirical evidence from Indonesia.
2. Developing a novel algorithm of the relationships between economic growth and its related factors, specifically ICT services capital.
3. Developing a new algorithm based on a unique and comprehensive dataset on ICT services and other growth factors for SMEs in Indonesia using a dataset comprising primary data from Indonesian SMEs, and secondary data from various sources.

A new algorithm was developed that utilised the dataset compiled during this research to identify and analyse the relationship between ICT services, SME output and growth. Since the dataset needed is not currently available, this new set of panel primary data provides a significant contribution for later studies, specifically in Indonesia.

Several studies have been conducted to investigate the role of ICT in a country's economic growth and also with regard to SME output, not only in developed countries such as the US, UK, Finland and Italy (Ilmakunnas and Miyakoshi, 2013; Ceccobelli and Mancuso, 2012; Jalava and Pohjola, 2008; Samoilenko and Osei-Bryson, 2008; Ordanini, 2006; Jorgenson and Stiroh, 1999), but also in developing and under-developed countries in Asia and Africa (Ridzuan and Ahmed, 2013; Santosa and Kusumawardani, 2010; Djiofak-Zebaze and Keck, 2009; Kuppusamy et al., 2008; Matambalaya and Wolf, 2001). Jalava and Pohjola (2008) found that in Finland, ICT contributed three times more than electricity, while Ordanini (2006) found that ICT played a significant role in improving Italian SME output. There are also several studies examining factors hindering and encouraging ICT service adoption by SMEs and these studies show that ICT adoption in Indonesia is still very low (Kartiwi and MacGregor, 2010; Santosa and Kusumawardani, 2010; Mourougane, 2012). However, there is no study investigating the role of ICT services on SME outputs that focus on how the best fit ICT Services solutions for SMEs can help to overcome the two key principal limitations of capital investment and human resource skills (Ross and Blumenstein, 2014).

The rapid growth of industrial ICT usage and existing evidence showing that ICT has a significant role in increasing productivity provided the motivation to use ICT to represent technology in a production function study.

Previous studies have found that ICT adoption by Indonesian SMEs is slow and it is, therefore, important to determine what role ICT service adoption by SMEs might have in boosting Indonesia's economic growth over the next decade. Studies found in the literature have investigated the relationship between ICT services and SMEs, or ICT and economic growth or SMEs and economic growth, but there remains a need to investigate the combined relationship between ICT services, SMEs and economic growth.

1.3 Research Objectives and Research Questions

The objective of this research was to investigate the role of ICT services in improving SME output and boosting Indonesia's economic growth. The research focus was divided into four specific objectives; and these formed the basis for the five research questions, depicted in Table 1-1 below.

The upside-down pyramid in Figure 1-3 presents the relationship between the five research questions. The research begins with the examination of the global trend of how ICT Services affect a national economy. To gain an understanding of the most recent global trends in developed and developing countries, a cross-country analysis was carried out. The findings address research question 1 (Q1) and research question 2 (Q2). Next, the analysis examines the Indonesian context. Following the global trend analysis, research investigating the role of ICT services in Indonesia's economic growth was carried out with a focus on SME adoption of ICT services. These findings address research question 3 (Q3).

The research includes a study of the relationships among Q1, Q2 and Q3. The results of the relationship study contributes to the development of the methodology used to identify and analyse the ICT services adoption factors. The research results were discussed and compared to work found in the literature and the outcomes provided the response to research questions 4 (Q4) and 5 (Q5).

Table 1-1 Research objectives and questions

Research Objectives	Research Questions
To investigate how ICT services contribute to economic growth, using ICT services capital as an explanatory variable in a novel algorithm.	Q1: What is the influence of ICT services on economic growth? Q2: What are the relationships between ICT services and other economic growth variables?
To understand the impact of SME ICT services adoption on Indonesia's economic growth.	Q3. What is the impact of ICT services on the Indonesian economy through their utilisation by SMEs?
To understand the issues of ICT services adoption on Indonesia's SMEs.	Q4: What are the significant factors influencing ICT services adoption by Indonesia's SMEs?
To gauge the significance of factors influencing cloud computing adoption by Indonesia's SMEs.	Q5: What are the factors influencing cloud computing adoption by Indonesia's SMEs?

1.4 Research Framework

The Cobb-Douglas production function is the most widely used aggregate production function in econometrics having been adopted as an approximate "universal law of production". It is also commonly used to explain the role of ICT in economic growth. The framework used during this research study was developed based on the Cobb-Douglass production function model. The model employs the following variables: 1) GDP or SME revenue as the production output; 2) ICT services consumed; 3) investment or total capital; and 4) labour hours worked. The proposed framework and a more detailed explanation of the variables are shown in Figure 1-4 and Table 1-2.

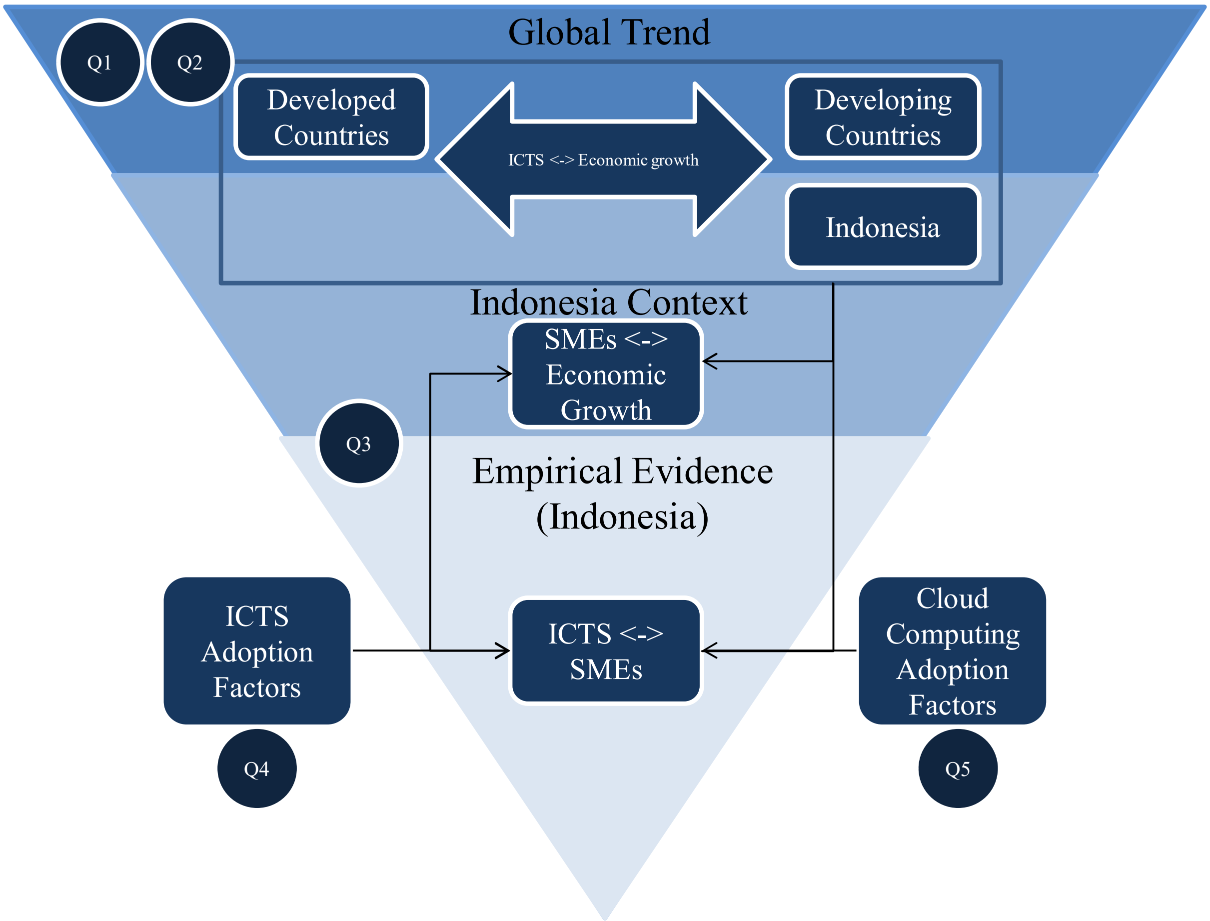

Figure 1-3 Research question relationships

The Cobb-Douglass production function assumes that the true production function can be closely approximated by a function of labour and total capital (Beer, 1980). This research framework proposes ICT capital and introduces ICT services capital as the independent variables in the model as a new algorithm. Furthermore, this research defines ICT services as an outsource service model including: fixed telephone services, mobile services, internet and cloud computing services. Instead of using ICT services penetration (ICT subscriptions/ 100 inhabitants) that has been used by previous studies (Djiofak-Zebaze and Keck, 2009; Turen et al., 2016), this study uses ICT services expenditure to represent the ICT service capital, because ICT services expenditure better represents the ICT services utilisation.

Table 1-2 presents the variables considered in this framework. They are: the output that represents real GDP Y, capital K that is equal to total capital minus ICT services capital $KICTS$ and total labour hours L. The ICT services variable will be disaggregated into: fixed telephone, mobile telephone, Internet, and cloud computing.

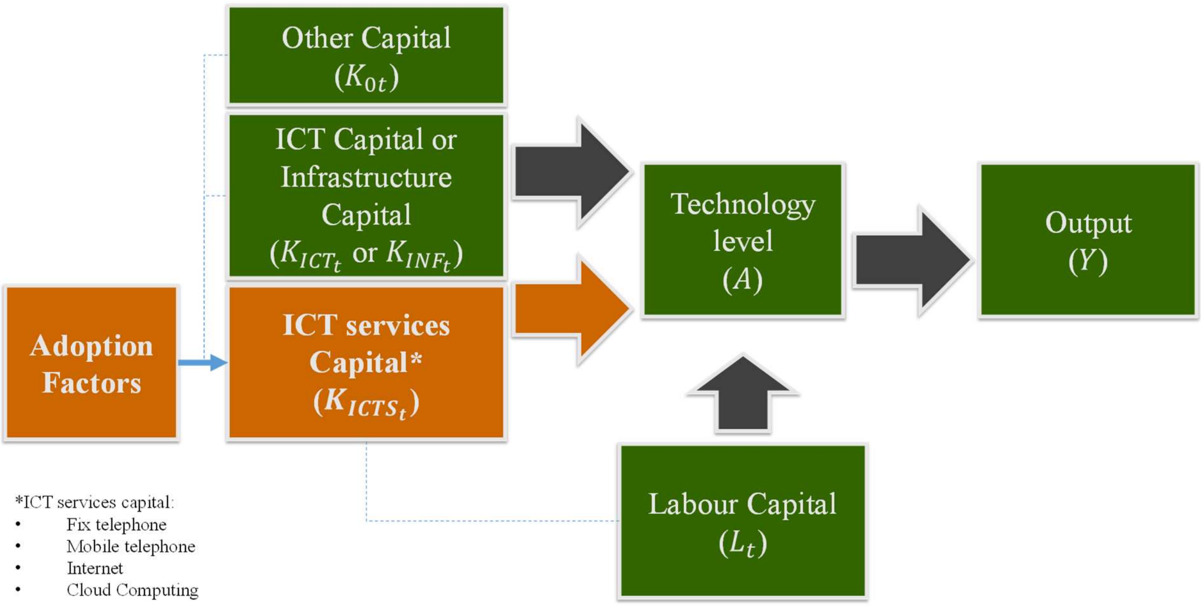

Figure 1-4 Proposed Framework

Y, which proxies for a nation's economic growth, is measured with the SME contribution to real GDP, or total annual SME revenue. Referring to Basu and Fernald (2007), because Indonesia does not produce a significant proportion of its own ICT services technology, the characteristic of the ICT service is as an outsource product, it is assumed that the technology level A in this research is a constant factor.

K is the non-ICT services capital (capital), that is derived from the total capital minus the ICT services capital, ICT capital is total cost related with in-house ICT (computer, ICT equipment, mobile phones) and installed software, while the ICT services capital is the cost related with ICT services that include fixed phone, Internet, mobile, managed services and cloud computing but excludes stand-alone or self-managed hardware and software.

Table 1-2 Variable definitions

Variable	Description	Proxy	Data
Output (Y)	Real GDP, or SMEs' annual revenue	Country output or SMEs' output; as the dependent variable	Real GDP in US$ or million IDR SMEs' annual revenue (million IDR)
TFP (A)	Other input variable that is not explained by capital and labour or a constant factor	Technology adoption level; as the constant factor or dependent variable	Technology adoption level (constant variable)
Total Capital (K)	Gross fixed capital plus change in inventory, or Total SMEs' capital minus SMEs' ICT capital.	Other capitals input; as the independent variable	Gross fixed capital + change in inventory, or SME's total annual expense and investment – SME's total ICT capital (million IDR)
Labour (L)	Total annual labour hours worked	Labour output input; as the independent variable	Annual labour hours worked (hours)
ICT Capital ($KICT$)	Total cost related ICT, including in house ICT services (ICT hardware includes in this variable)	Total ICT input, including hardware and software; as the independent variable	Total ICT capital-SME's ICT service capital (million IDR)
ICT service Capital ($KICTS$)	ICT services usage or cost related to ICT services (fix: fixed phone, mb : mobile, int : Internet, cc: cloud computing)	ICT services input ; as the independent variable	Total ICT services provider revenue, or SMEs' ICT service spending (million IDR)

To proxy L, annual total labour hours is utilised in this research instead of total labour hours, because labour wages per employee may vary from micro SMEs to medium SMEs, while labour hours per employee is relatively similar among SMEs.

The SME contribution to GDP and Total capital data is based on data from the Indonesian Ministry of Cooperatives and SMEs (MCSME / Kementrian Koperasi dan UMKM). Labour hour data was drawn from Indonesia's Central Statistical Bureau (Biro Pusat Statistik), and ICT capital was taken from various sources, predominantly from PT Telkom, other ICT service provider data and from the International Telecommunication Union (ITU). A survey data set was used to gather more detailed data and to produce a projection for the next five years.

To examine the factors influencing the adoption of ICT services, specifically cloud computing, this study combines two technology adoption frameworks. The first framework is the TAM that represent the individual perspective. The second framework is the TOE framework that represents the corporate perspective. There are five groups of factors to be examined: 1) management; 2) employee; 3) industry; 4) innovation; and 5) other ICT services. The study then uses an econometric technique, the binary choice probit model, to determine the significant factors. The combination of TAM and TOE to investigate the adoption factors from the individual and organisational perspective is another new algorithm proposed by this research.

1.5 Research Methodology

The research was carried out in four sequential stages. The first stage was the research design, beginning with a literature review to explore current theoretical knowledge and its significance. The literature explored included ICT services, SMEs, growth theory, output and Indonesian contextual references. Drawing on previous studies, the research problem and its significance were identified. Research objectives and questions were then developed to address the research problem. The literature review also assisted when designing the research framework to provide a conceptual framework for the study.

The two research methods used in this research are primary and secondary data analysis. The research methodology included the use of econometric techniques to complete the primary and secondary data analysis. A field survey was conducted to obtain more detailed historical data and industry-based predictions. A detailed survey plan was developed at this stage to identify targeted respondents, design a structured sound questionnaire, develop an implementation plan and obtain an ethics approval.

Data collection was carried out during the second stage. Given the research methods, this stage included two major activities: primary data collection and secondary data collection. Details of the primary and secondary data collection are given in Sections 1.5.1 and 1.5.2.

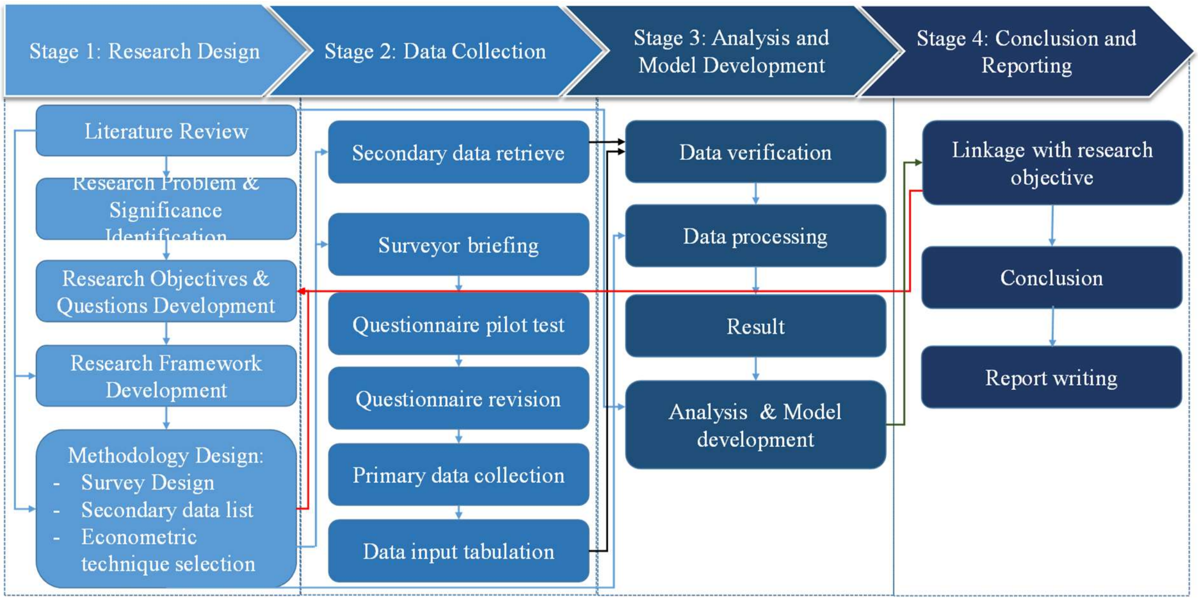

Figure 1-5 Research methodology

After the primary and secondary data were collected, data analysis and model development were conducted during stage 3. Before being processed, the data was verified to ensure that the data was valid, reliable and errors were minimised. The data was then processed using software including Microsoft Excel, E-Views and Stata and the results were analysed. Empirical analysis and model development were carried out drawing on the work found in the literature to provide comparative discussion.

The final stage involved analysing the research results and drawing conclusions. During this stage, the empirical analysis and models were linked to the research questions and objectives. Further discussion of the research outcomes brought the study to a close.

1.5.1 Primary Data (Field Survey Data) Analysis

The objective of the primary data analysis is to examine the impact of ICT services, utilised by SMEs, on the Indonesian economy and to consider the influence of cloud computing, security and privacy issues for SMEs, and SME needs for ICT services over the next five years. The primary data analysis related to Q3, Q4 and Q5 as shown in Figure 1-6.

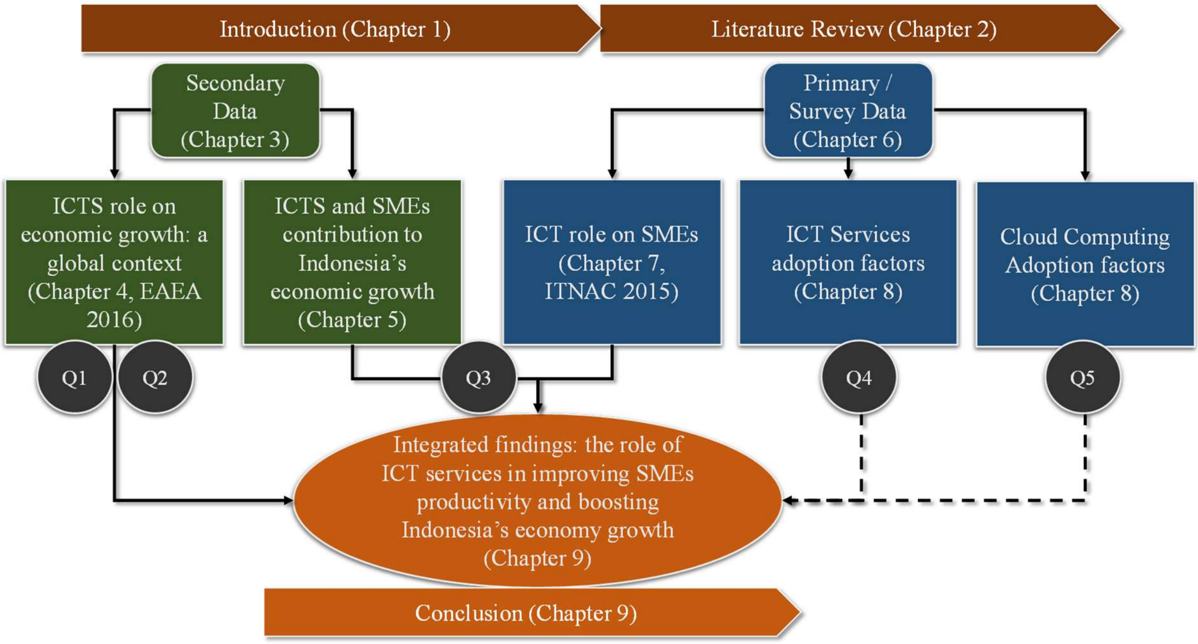

Figure 1-6 Primary and Secondary data analysis

Overall results and recommendations were formulated to address the main objective which is to investigate the role of ICT services in improving the SME output and boosting Indonesia's economic growth. The field survey gathered detailed data for quantitative analysis and to determine the key factors related to the proposed new and novel algorithm.

This survey used a structured questionnaire as the main tool. The questionnaire was prepared and designed comprehensively before the survey to ensure that the sections and questions related to the research questions. The questionnaire design considered the interrelationship between sections, clarity and readability. Before the survey was conducted, the questionnaire was pre-tested and refined. The questionnaire was also translated into Indonesian and the survey was in conducted in Indonesian.

The field survey was carried out from March to November 2015 by a third party, Bandung Technopark, an institution that has the capability and experience to conduct field surveys on Indonesian SMEs. The survey covered four Indonesian cities: Jakarta, Bandung, Semarang and Denpasar. The media used in this survey were e-mail, telephone and direct (face-to-face) contact. Details of how the survey was carried out are set out in Chapter 4.

The primary data was processed and analysed using econometric analysis, a panel regression analysis incorporating the Cobb Douglass Production Function approach. The findings address Q3, and are reported in Chapter 7. The preliminary result of this analysis has been presented on the International Telecommunication Network and Application Conference (ITNAC) 2015[1]. Employing a probit regression and the technology adoption framework on the primary data, significant factors affecting ICT services, specifically Cloud Computing adoption on Indonesia's SMEs were identified. The results presented in Chapter 8 address Q4 and Q5.

1.5.2 Secondary Data Analysis

For the secondary data analysis, a panel regression technique was used to analyse ICT services and the SME role in national economic growth. This analysis addressed Q1 and Q2. The preliminary result of this analysis has been presented on the 15th International Convention of the East Asian Economic Association (EAEA) Conference[2]. The role of SMEs in the Indonesian economy was also analysed utilsing secondary data and supported by a targeted analysis of the primary data, to address Q3.

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[1] *S. Rachman, M. A. Gregory and S. W. Narayan, "The role of ICT services on Indonesian Small to Medium Enterprise productivity," Telecommunication Networks and Applications Conference (ITNAC), 2015 International, Sydney, NSW, 2015, pp. 166-172*

[2] *Narayan, S., Rachman, S., and Gregory, M.A. (2016). The Role of Information and Communication Technology Services on Economic Growth: Global Evidence, The 15th International Convention of The East Asian Economic Association (EAEA), Bandung, Indonesia, 5-6 November 2016*

A series of panel data sets from 28 developed countries and 15 developing countries over the period 1970 to 2013 were gathered from various sources. Real GDP, as the dependent variable, was drawn from the World Bank's database. Total capital came from the gross fixed capital plus the change in inventory, from the International Monetary Fund's (IMF) annual database. *L* was represented by annual labour hours worked, where the total value for labour is sourced from the International Labour Organisation's (ILO) database, while labour hour rates were sourced from the ILO's database and the IMF's annual database. The ITU database provided information for ICT services capital and its aggregates: fixed phones, mobiles, etc. The GDP, total capital and ICT services capital, and their aggregates were converted into million US$. The data series are on an annualised basis.

ICT services were introduced for Indonesian SMEs in the late 1990s, and data became available after 1998, with complete data sets available from 2003 to 2012. The data sets were collected from several sources. The Central Statistical Bureau (Biro Pusat Statistik Indonesia / BPS) provided data with regard to hours worked in SMEs, while the MCSME provided the number of SMEs, number of SMEs employees, SMEs share to Indonesia's GDP, and SMEs total capital. The data on ICT services capital were derived from the ITU.

Secondary data that is currently available does not provide details for the SME class (micro, small and medium) and the ICT services capital that is needed to identify segments that may contribute in the future. A field survey was conducted to gather the detailed data needed for an in-depth study of ICT services penetration within SMEs.

1.6 Thesis Organisation

This thesis is divided into nine chapters. Figure 1-6 presents the flow of the chapters, reflecting the processes and stages in the investigation of the role of ICT services as an accelerator to SME output and as a boost to Indonesia's economic growth.

Chapter 1 provides an overview of the thesis as an introduction to the study. First, the research background explains the importance of SMEs in the national economy and ICT services as a promising solution to help SMEs grow. Second, the research objectives and research questions are set out. Third, the research framework and research methods section outlines how this study was conducted.

Chapter 2 presents a literature review that begins by discussing the importance of ICT services and current ICT services trends, specifically cloud computing. It also explains the situation of SMEs, specifically in Indonesia. The chapter continues by reviewing studies about ICT adoption by SMEs. To address the research methodology, this chapter presents growth theory, specifically the Cobb-Douglass Production Function approach, and the technology adoption models, TAM and TOE. Finally, it reviews previous relevant studies that have adopted the Cobb-Douglass Production Function, also the TAM and TOE frameworks.

Chapter 3 describes the secondary data methods and analysis techniques applied in the study. This chapter also reports on the secondary data utilised in the study. The secondary data section highlights the validity of the data sources; the World Bank, IMF, ILO, ITU, and the Indonesia Statistical Bureau. Next, it explains the analysis techniques used to complete this study incorporating the Cobb Douglass Production Function framework and the panel data estimation.

Chapter 4 reports on the first stage of the secondary data analysis. This stage examines the ICT services role on economic growth from a global perspective. A cross-country analysis involving 28 developed countries and 15 developing countries was carried out. This stage addressed Q1 and Q2.

Chapter 5 addresses the second stage of the secondary data analysis. This stage sets out the Indonesian context when considering the implications of the ICT services and SMEs on the national economy. It incorporates the primary data analysis reported in Chapter 7, and this second stage of the secondary data analysis addresses Q3.

Chapter 6 describes the primary data, a new, unique and comprehensive ICT services and SMEs dataset gathered from the field surveys in four Indonesian cities. The report covers the field survey plan, the data gathering process, and the primary data set applied in this study. The primary data was used to analyse the role of ICT services on Indonesia's SMEs and the ICT services adoption factors. The primary data analysis and findings are reported in Chapter 7 and Chapter 8.

Chapter 7 discusses the primary data analysis and results of the study into ICT services adoption by Indonesian SMEs. The analysis provides a linkage with the secondary data analysis results provided in Chapter 5 that relate to the Indonesian context. The findings presented in this chapter address Q3.

Chapter 8 focuses on the primary data analysis and examines possible factors influencing the adoption of ICT services by Indonesia's SMEs, specifically cloud computing. This chapter explains the adoption framework, the TAM and TOE framework, and probit data analysis that are used to analyse the ICT services adoption factors. The findings discussed in this chapter relate to Q4 and Q5. This chapter is divided into two parts. The first part examines fixed telephone, mobile telephone and Internet adoption factors. While the second section examines the cloud computing adoption factors.

Chapter 9 concludes the research and summarises the research motivation, relevant theories underpinning the study, theoretical and practical contribution of this study, and the findings from the proposed algorithms and models. The limitations of the research scope are discussed and practical implications of this study are described.

1.7 Summary

SMEs are a significant industry sector that contributed 60.3 percent of total Indonesian GDP in 2013 an increase from 56.1 percent in 2003. SME growth is slower than large enterprises which are growing about 19.2 percent annually, while SME growth was 14.2 percent annually over the period 2003 to 2013.

Capital investment, technology and labour are the main sources of economic growth according to modern economic growth theory based on the production function model, first described by Cobb-Douglass. The Cobb-Douglass production function is the most commonly used model found in the literature to investigate the role of ICT on economic growth and in such areas as agriculture, energy, organisation effectiveness and health services. Studies found in the literature on the role of ICT on economic growth highlight the role of ICT investment on productivity.

ICT is moving from an in-house to outsourced service model that makes services cheaper overall and accessible for 24 hours in 7 days from any network connection. SME adoption of an outsourced ICT service model has been highlighted in recent studies found in the literature as a way to improve output and to survive in competition with large enterprises. As the global trend to use outsourced ICT services increases, it is important to investigate the role of ICT services in accelerating Indonesian SME output. The research outcomes will be used to forecast how ICT services can accelerate Indonesia economic growth over the next five years.

This research considers SME ICT services as an explanatory variable by adopting the Cobb-Douglass production function to investigate the impact on economic growth. A five-year forecast and analysis of future SME ICT services needs has been identified through the development of a framework and novel algorithm that is based on the Cobb-Douglass Production function to capture ICT services as an explanatory variable.

This research contributes to knowledge by explaining the role of ICT services as an explanatory variable for SMEs output affecting national economic growth. The research outcomes are significant as they provide new knowledge on the benefits of ICT services adoption by SMEs. The research contributes to the implementation of Indonesian ICT services development by existing or new ICT service providers. The Indonesian Government can utilize the research outcomes as an information source when considering legislative and regulatory changes related to ICT services adoption by SMEs. This study provides important data and research outcomes that might be relevant to other emerging economies.

This thesis is organized as follow. Chapter 2 provides a literature review. Chapter 3 describes the secondary data analysis technique, and identifies the secondary data utilised in this study. The secondary data analyses and findings are described in Chapter 4 and 5. Next, Chapter 6 presents the primary dataset gathered from the field survey. Empirical evidence regarding the ICT services contribution on SMEs output that is based on the primary data analysis is provided in Chapter 7. Chapter 8 presents the primary data analysis of factors affecting the adoption of ICT services, specifically on cloud computing. The conclusion and suggested future work is provided in Chapter 9.

Chapter 2 Literature Review

2.1 Introduction

This chapter examines the literature on ICT, SMEs, and economic growth. The chapter is organised as follows. Section 2.2 briefly discusses the literature pertaining to the global trends in ICT services. Next, studies about ICT impact on the economic growth are reviewed in Section 2.3. This is followed in Section 2.4 by an explanation of cloud computing. In Section 2.5, the current situation for SMEs in Indonesia is examined. Section 2.6 focuses on ICT adoption by SMEs, followed by an explanation of the growth theory in Section 2.7. The empirical studies on the influence of ICT on economic growth and SMEs applying the Production Function approach are described in Section 2.8. Section 2.9 summarises various studies on the influence of ICT on economic growth and SMEs that are using approaches not covered by the production function. Finally, the technology adoption theory is explained in Section 2.10

2.2 ICT Services

2.2.1 ICT Service Capital

Over the past decade, the ICT delivery model has evolved from the traditional in-house ICT[3] model to an outsourced ICT services model. This has enabled the SMEs to benefit from having state-of-the art ICT services with minimum capital outlay and human resource skills. The most basic, outsourced ICT services model comprises the fixed-line telephone, mobile phone and Internet services, while the more recent outsourced ICT services model that has been designed to meet the current and future needs of most organisations includes Cloud Computing. Research from the literature highlighted empirical evidence of the significant role of ICT services in boosting economic growth. ICT services, that consist of broadband Internet

[3] *The in-house ICT includes infrastructure, hardware, software and telecommunication equipment.*

connection and complementary broadband applications (VPN, video communications, email, file sharing, etc), are considered to be vital for SME growth, because they offer an efficient and permanent connectivity to the global market at a price that many SMEs can afford (Colombo et al., 2013). ICT is classified into three groups: (1) general-use ICT that includes Internet access and computer; (2) communication-integrating ICT that comprises e-mail, intranet and extranet; and (3) market-oriented ICT that includes web pages and e-commerce (Lucchetti and Sterlacchini, 2004).

Researchers tend to use the term 'ICT' to represent the technology referred to in their studies; however, it has various definitions and a broad scope. Bayo-Moriones et al. (2011) considered that in-house and outsourced ICT services included network technologies (in particular, communications and ICT systems) along with computer, software and communication equipment. ICT, as an outsourced service delivery model, has also been defined as 'the convergence of telecommunications and computing' (Gibbs and Tanner, 1997). Some studies (e.g. Samoilenko and Osei-Bryson, 2008; Lee et al., 2011) use the term ICT to represent the telecommunications infrastructure. Mourougane (2012) defines ICT capital as the ICT goods and software capital. Jorgenson and Stiroh (1999, 2003) included only ICT investment equipment used in the production of ICT. In the United States, ICT industries include those that manufacture machinery, computer and electronic products, and electrical equipment, appliances, and components (Basu and Fernald, 2007). Hofman et al. (2016) used investment in computer equipment and telecommunications data to represent in-house ICT capital in their studies of the contribution of ICT to economic growth and productivity in Latin America from 1990 to 2013.

The ITU (2009, 2010a, 2010b), the OECD (2006), the United Nations Conference on Trade and Development (UNCTAD) have adopted a similar framework for ICT measurement based on the basic three-stage model: stage 1 – ICT readiness, reflecting the level of ICT infrastructure and access; stage 2 – ICT use and intensity, reflecting the level of use of ICT and the capacity to use ICT effectively; and stage 3 – ICT impact, reflecting the result of efficient and effective use of ICT in the society. In the study conducted by Lee and Brahmasrene (2014), the indicators measuring ICT readiness included fixed telephone lines per 100 people and mobile cellular telephone subscriptions per 100 people. Indicators measuring ICT use and intensity included Internet users per 100 people and fixed broadband Internet subscribers per 100 people.

Three sub-indicators have captured the different stages of the digitalization process, measuring, respectively: (a) the level of ICT infrastructure (ICT access dimension), (b) the level and quality in the use of ICT by individuals and firms (ICT usage dimension), (c) the personal and social empowerment of digitalization in key socio-economic areas: Education, Labour, Health, Government, Economy, Culture and Communication (ICT empowerment dimension) (Evangelista et al., 2014).

According to Global Insight Inc., ICT expenditure includes hardware (computers, storage devices, printers, and other peripherals), software (operating systems, programming tools, utilities, applications, and internal software development), services (information technology consulting, computer and network systems integration, Web hosting, data processing services, and other services), communications services (voice and data communications services), and wired and wireless communications equipment (Youssef et al., 2011).

Turen et al. (2016) used ICT connectivity as an indicator of national ICT capability. Their measurement was based on fixed (wired) broadband subscriptions per 100 inhabitants, fixed-telephone subscriptions per 100 inhabitants, fixed (wired) Internet subscriptions per 100 inhabitants, percentage of individuals using the Internet and mobile-cellular telephone subscriptions per 100 inhabitants. Despite the various definitions of ICT, studies have found that ICT plays an important role in the growth of an economy. As a general-purpose technology, ICT such as a computer does not automatically increase productivity, but it is an essential component of a broader system of organizational changes which do increase productivity (Brynjolfsson and Hitt, 1998).

In this research, ICT services are defined as an outsourced service model comprising fixed telephone services, mobile services, Internet services, and Cloud Computing. In-house ICT is also included in this study, to provide a comparison with outsourced ICT services. The separate study of these two technology delivery models is important in order to understand SME readiness to adopt ICT services.

2.2.2 ICT Global Trend

The world's economic balance is shifting from the developed to the emerging countries, where the average year-on-year growth of ICT in emerging economies reached 8.7% compared to the world growth rate of 6.6%. This shows that the majority of developing economies have acknowledged the role of ICT in their future development (Turen et al., 2016). The year-on-year growth in ICT has been higher in the developing world in comparison with the developed world (Ghani, 2015). Developing countries have significantly increased the number of ICT users. For instance, the number of Internet users in China grew from one million users in 1997 to 400 million users in 2011 (Dedrick et al., 2011). For developing countries, the World Bank Group (2006) reports that firms that use ICT become efficient and more competitive (Youssef et al., 2011). IT investments resulted in productivity gains for some developed and industrializing countries, but not significantly for developing ones (Dedrick et al., 2011).

Since 2000, Southeast Asian countries (ASEAN) have been working together to improve their ICT sector by: increasing intra-regional trade in ICT products; improving the quality of human capital in order to catch up with the development of ICT products; establishing infrastructures that are necessary for the development of the ICT sector; and optimising extra-region power by strengthening their cooperation with relatively more developed countries particularly with regard to ICT (Irawan, 2014).

In the mid-2000s, IT capital investment began to fall sharply due to slowing economic growth, the collapse of many Internet-related firms, and reductions in IT spending by those firms facing fewer competitive pressures from Internet based firms. This reduction in IT investment had devastating effects on the IT-manufacturing sector, and led to slower economic and productivity growth in the U.S. (Dedrick et al., 2003).

Communication Today Magazine (October 2013), predicted that the total ICT services consumed by SMEs in emerging markets would increase from USD 94.01 billion in 2013 to USD 113.19 billion in 2018, at a Compound Average Growth Rate (CAGR) of 3.8 percent; while in developed markets, it would have a slower growth rate of CAGR of 1.1 percent from USD 117.67 billion in 2013 to USD 124.44 billion in 2018. Mobile voice and data would continue to be extremely important to SMEs in emerging markets, because coverage would be far wider and the cost would be more competitive. The adoption of fixed-line services, both voice and broadband, would also contribute significantly to this growth, as operators roll out improved infrastructure and increase coverage, and as the cost of these services decreases.

2.2.3 ICT Service Adoption

The global adoption of ICT services has become increasingly important in our daily lives. Of the four types of ICT services, (mobile phones, fixed telephones, Internet and Cloud Computing) mobile and Internet usage is growing faster than the other services. By the end of 2016, some 3.5 billion people or 47.1% of the world's population will be online, up from 3.21 billion people in 2015 (equivalent to 43.8% penetration). The target of 60% Internet user penetration is unlikely to be achieved until 2021 at the earliest. In the developing world, Internet penetration will reach 40.1% by the end of 2016 (up from 24% five years earlier).

However, the least developed country (LDC) target of 15% should be achieved in 2016, with a projected penetration of 15.2% in LDCs by the end of 2016 (ITU, 2016a).

The adoption of ICT by firms will positively affect their productivity and innovation performance. ICT drives business process efficiency. For example, an online platform brings suppliers and customers "closer" to the firm. Additionally, ICT, especially the Internet, is used for communication and improves corporate knowledge. The Internet increases access to members of the industry through improved communication capability, which provides learning facilities regarding new technologies that eventually accelerate innovations (Paunova and Rollo, 2016). Due to this disruptive nature and far reaching consequences, ICT services have become a significant and unavoidable aspect of our daily lives.

To begin with, Internet and mobile phones are the two services that have grown far more quickly than other services. In developing countries, the number of mobile phone users has increased far more rapidly than in developed countries. This is due to the lack of landline infrastructure in developing countries (James, 2011; Howard, 2009). However, although the fixed telephone network is unreliable, and mobile services are in greater demand due to their higher reliability, mobile and fixed line services should exist in parallel. Additionally, with an increase in competitively-priced services, innovative smartphones and an increasing range of apps, mobile broadband traffic will continue to rise (Reseach and Markets, 2017).

Nonetheless, there are significant differences in the penetration of ICT services between the developed and developing countries. Using ITU (2016b) data, Table 2-1 summarises ICT and ICT services penetration for developed and developing countries. Internet penetration in 2015 was 78.1% and 36.7% for developed and developing countries, respectively.

In 2016, the fixed and mobile broadband penetration per 100 inhabitants in developed countries reached 60.2% (or 1.5 billion subscribers), while in developing countries is 24.6%

(or 3 billion subscribers). Meanwhile, fixed telephone penetration per 1000 inhabitants in developed countries is 37.3% (or 471 million subscriber), whereas in developing countries it is 8.8% (or 542 million subscribers). In addition, the mobile telephone penetration per 100 inhabitants in developed nations is 126.7% (1.6 billion subscribers), while in developing nation reach 94.1% (5.8 billion subscribers) (ITU, 2016b).

Table 2-1 Key ICT indicators for developed and developing countries*

	People (millions)			**Penetration (per 100 inhabitants - in %)**		
	2015	2016**	growth	2015	2016**	growth
Developed						
Fixed-telephone subscriptions	483.7	470.9	-3%	38.5	37.3	-3%
Mobile-cellular telephone subscriptions	1577.3	1599.5	1%	87.1	90.3	4%
Active mobile-broadband subscriptions	1092.6	1140.2	4%	29.4	30.1	3%
Fixed broadband subscriptions	368.6	380.2	3%	29.4	30.1	3%
Households with a computer	N/A	N/A	N/A	81.0	82.4	2%
Households with Internet access at home	N/A	N/A	N/A	81.3	83.8	3%
Individuals using the Internet	979.9	1023.1	4%	78.1	81.0	4%
Developing						
Fixed-telephone subscriptions	565.5	541.7	0.0	9.3	8.8	-5%
Mobile-cellular telephone subscriptions	5638.3	5777.4	0.0	93.0	94.1	1%
Active mobile-broadband subscriptions	2139.6	2513.3	0.2	35.3	40.9	16%
Fixed broadband subscriptions	451.6	503.7	0.1	7.4	8.2	10%
Households with a computer	N/A	N/A	N/A	33.1	35.2	6%
Households with Internet access at home	N/A	N/A	N/A	37.6	41.1	9%
Individuals using the Internet	2227.1	2464.8	0.1	36.7	40.1	9%

*Notes: * This table covers statistics all countries covered by the ITU (2016b). ** 2016 figures are estimates. Source: ITU (2016b).*

Furthermore, the exponential speed with which ICT has been adopted in recent years has disrupted major industries. If ICT adoption is managed successfully, it will provide many benefits. Baller et al. (2016) explained ICT disruption in the following ways. First is the change to innovation. ICT offers near-costless digital innovation. One of the innovations is the shift of existing products or services to a digital format, which has a significant impact on a company's productivity. The creation of new business models, including platform businesses, through the utilisation of ICT such as the pay per use business model, is also a creative innovation that needs minimal investment capital. Other digital, cost-effective innovations include distributed manufacturing, blockchains, advertising-based "free services", and crowd-sourcing. Driven by greater competitive pressure, digital innovations have become rampant. Patents, as the traditional innovation parameter, cannot adequately reflect the challenge of new innovations. Secondly, ICT has disrupted existing career paths, eliminated several job skills but, on the other hand, has created new ones. At the same time, ICT-based job platforms are increasingly being used to match workers with jobs, leading to increased freelance activity. Thirdly, ICT has brought changes to the education sector that can provide life-long learning. Finally, ICT adoption raises new challenges in multiple arenas, not only in terms of economic imperatives. It also creates new types of leadership and behaviours, as well as more flexible approaches to governance.

However, if the risks associated with ICT adoption are not appropriately addressed, challenges such as the rising threat of cyber attacks that extend into the physical world, privacy issues, and the polarizing effects of technologies on labour markets, could derail the benefits of ICT (Baller et al., 2016).

2.3 The influence of ICT on Economic Growth

Empirical evidence indicates that ICT services (in-house and outsourced) play an important role in economic growth. In-house ICT technologies, such as desktop computers, do not automatically increase productivity, but are an essential component of a broader organizational change process, which does increase productivity (Brynjolfsson and Hitt, 1998; Ridzuan and

Ahmed, 2013). In-house ICT is also found to complement human capital (Ketteni, 2001) as well as labour and other capital (Jorgenson and Stiroh, 1999, 2003). However, other studies also suggest that in-house ICT does not contribute significantly to economic growth in Indonesia, the Philippines, Thailand Kenya and Tanzania (Matambalaya and Wolf, 2001; Kupussamy et al., 2013).

Only a limited amount of research has examined the economic impact of outsourced ICT services on a developing country. The growth of outsourced ICT services has shown benefits to organizations in terms of reduced business transaction costs, information dissemination and organizational efficiency (Baquero, 2013). Outsourced ICT services, that consist of broadband Internet connections and complementary broadband applications (Virtual Private Networking (VPN), video communications, email, and file sharing), are a motivator for organizations because of the additional business capability provided and ability to efficiently participate in global markets (Colombo et al., 2013).

Since differences between the penetration of ICT services exist between developed and developing countries, see Section 2.2.2, Sections 2.3.1 and 2.3.2 examine the implications of ICT services on the economic growth of developed and developing nations from previous studies.

2.3.1 Developed Countries

The literature review indicates that the majority of the previous studies on ICT utilizing an in-house model focused on developed countries.

A country-level study by Jalava and Pohjola (2007), used a growth accounting methodology to measure the ICT contribution (as a component of aggregate output and input) to Finland's economic growth between 1995 and 2005. Jalava and Pohjola found that in-house

ICT accounted for 1.87 percent of the observed labour productivity growth at an average rate of 2.87 percent and the contribution from increases in ICT capital intensity was 0.46 percent.

Ketteni (2011) used the general production function to explore the interaction and influence of in-house ICT on the output elasticity of human capital and vice versa (ie the influence of the output elasticity of human capital on in-house ICT) in the U.S. Ketteni found that countries with high levels of ICT capital had high output elasticity for human capital.

Jorgenson and Stiroh (1999) also studied the U.S. using production function theory and found that lower computer prices increased IT capital spending as a substitute to other capital and labour input from the period 1990 to1996.

In the same way, several studies on the OECD and other developed countries found that ICT (in-house and outsourced) plays a significant role in economic growth (see, Ilmakunnas and Miyakoshi, 2013; Ceccobelli et al., 2012; Samoilenko and Osei-Bryson, 2008; Vicenzi, 2012; Dimelis and Papaioannou, 2012).

However, other studies have found that ICT (in-house and outsourced) has no impact (Ishida, 2015; Zelenyuk, 2014), providing a point of contention. In Japan, the long-run coefficient estimate for in-house ICT investment is for a statistically insignificant increase in GDP (Ishida, 2015). From 1980 to 1995, the increased capital investment in ICT (in-house and outsourced) was found to be unrelated to the increase in labour productivity in selected developed countries (Zelenyuk, 2014).

2.3.2 Developing Countries

In contrast to the number of previous studies relating to ICT services in developed countries, the number of studies on ICT services in developing countries is limited. Most of the available studies follow the in-house model for defining ICT. Ridzuan and Ahmed (2013) found a positive impact of in-house ICT investment on economic growth in eight Asian countries between 1975 to 2006. Other studies that explored ICT utilization in developing countries were carried out by Kuppusamy et al. (2008); and Matambalaya and Wolf (2001).

Kuppusamy et al. (2008) found a long-run co-integration relationship between ICT-based investment and economic growth for Australia, Malaysia, and Singapore. However, the authors found that ICT investment in Indonesia, the Philippines, and Thailand did not contribute significantly to economic growth during the same period. Erumban and Das (2016) found that India's export-oriented ICT focus contributed significantly to aggregate productivity growth and has led to efficiency gains in its fast-growing service economy

Irawan, (2014) showed that in the Association for Southeast Asian Nations (ASEAN), more developed countries did not necessarily derive greater benefit from ICT (in-house and outsourced) than did the less developed countries. The impact of ICT on the economy depended on the structure and the intensity of the ICT sector in the economy.

However, Dedrick et al. (2013) found that higher-income developing countries have achieved positive and significant productivity gains from IT investment in recent years as they have increased their IT capital stocks and gained experience with the use of IT. The study found that the effect of IT on productivity is extending from the richest countries to a large group of developing countries. The study indicates that lower-income developing countries can also expect productivity gains from IT investments.

Hofman et al. (2016) examined the case of Latin America where total capital was found to be the main source of economic and productivity growth, while the role of ICT (in-house and outsourced) was less than one sixth of the total capital contribution. The authors found that total capital went hand-in-hand with high investment, especially for ICT.

Matambalaya and Wolf (2001) found that ICT (in-house and outsourced) had no signficant effect on SMEs in Kenya and Tanzania for the period from November 1999 to December 2000.

Thompson Jr. and Garbacz (2007) explored the impact of communication networks and economic reform on economies using a panel of 93 developed and developing countries for the period from 1995 to 2003. The study found that institutional reforms and growth in telecommunication networks benefit all nations to some degree, and developing nations benefits from improved information flows and economic efficiency.

2.4 Cloud Computing

There are various definitions of Cloud Computing that see it as a new business model and computing paradigm, which enables on-demand provisioning of computational and storage resources (Xiao and Xiao, 2013).

The Cloud Computing service model consists of five essential characteristics and three service models. The Cloud Computing characteristics are: 1) on-demand self-service: users can provision services automatically without any human interaction, 2) broad network access: the services can be used through various client platforms such as mobile phones, laptops, tablets, etc., 3) resource pooling: the provider's computing resources are pooled to serve multiple consumers, 4) rapid elasticity: capabilities can be elastically provisioned and released, and 5) measured service: cloud systems automatically control and optimize resource use (NIST, 2013). Meanwhile, the three services models are: 1) Software as a Service or SaaS such as web-based email (Gmail, Yahoo, Hotmail), Google docs, and other business applications (accounting, inventory); 2) Platform as a Service or PaaS such as web store, Google app engine, payment gateway, social networking websites (Facebook, LinkedIn, Twitter, and Instagram); and 3) Infrastructure as a Service or IaaS such as storage (Dropbox, Google Drive).

Researchers and service providers suggest that Cloud Computing services provide the most appropriate platform for SMEs to challenge large enterprises as Cloud Computing services can reduce the effect of the traditional challenges faced by SMEs in terms of capacity, ICT human resources and financial constraints. Furthermore, they can assist to exploit SME business opportunities across national borders (Ross and Blumenstein, 2014).

Cloud Computing services provide benefits and improved opportunities for SMEs to increase their entrepreneurial activity through four factors: 1) increasing global collaboration; 2) reducing opportunity costs; 3) scalability and accessing global markets; and 4) increasing access to international venture capital. Those factors link to the four Cloud Computing concepts. First is the increase in innovation. Cloud Computing services help SMEs to survive and engage in product and service development that might not have occurred previously, because of the traditional up-front ICT capital expenditure models that prevented SMEs from fully adopting ICT. Secondly, Cloud Computing services can help SMEs with their start-up operations. Here the on-demand payment model can reduce in-house ICT sunk costs by lowering the risks associated with developing new ICT-related or supported projects. Thirdly, the cloud can increase business agility as it allows firms to quickly increase the demand for products and services that prove successful in the marketplace. Increased access to global markets is the fourth advantage of Cloud Computing, as it is possible to have relatively low variable costs when ICT-related products and services can be provided over the Internet (Ross and Blumenstein, 2014). Figure 2-1 depicts the relationship between the factors and concepts.

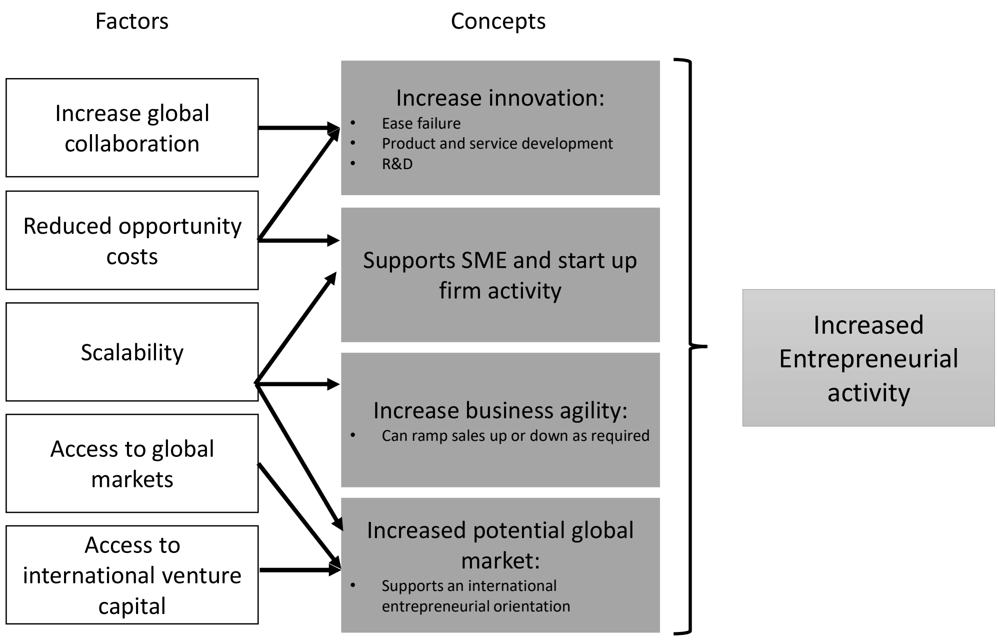

Figure 2-1 Cloud Computing and Entrepreneurship

Source: (Ross and Blumenstein 2014)

Despite all the aforementioned benefits of Cloud Computing services, security and privacy are the major challenges in the adoption of Cloud Computing, which implements a shared service model that makes it possible to provide on demand and low cost services to a large consumer base. Security and privacy systems may contribute to a higher service cost. Another challenge is the integration of traditional ICT systems with Cloud Computing services, or even the migration from a manual business process to the new ICT service model. Vendor locking also discourages the SMEs from using Cloud Computing services, as SMEs generally do not have bargaining power with large service providers (Ross and Blumenstein, 2014).

According to a survey by Circle Research Global in 2015, out of 800 senior SME decision makers with up to 1,000 employees, 90% felt that cloud adoption was becoming increasingly important for their business success (ProQuest, 2016). In order to realize the true potential of Cloud Computing, SMEs need to consider several other products and technologies as well, which would form a complete a cloud eco-system. First, use thin clients instead of regular desktop PCs to access cloud-based apps. Second, the right mobile devices are required that enable access to the cloud from anywhere at any time, and from any device. Third, and most importantly, Internet bandwidth must be adequate and consistent, without which, it would be pointless to move to a cloud based environment.

Moreover, cloud-based technologies are supporting collaborative international new ventures by linking SMEs and start-up firms to potential partners and venture capital via Internet-based *crowdfunding* sites (Roos and Blumenstein, 2015).

According to The Asia Cloud Computing Association's Cloud Readiness Index (CRI) 2016, Indonesia is ranked eleventh, climbing from its twelfth position in 2014. The improvements seen in cloud readiness and adoption have been led by private sector innovation, as a growing online population continues to demand more robust digital services (ACCA, 2016).

Asia Pacific outperforms the other markets on the basis of physical infrastructure, scoring well for international connectivity, broadband quality, green and sustainable policies, and data centre risk. This puts Asia in a strong position to lead the next wave of global innovation and leadership in technology (ACCA, 2016).

Four parameters are used to measure "hard infrastructure" capacity: international connectivity; broadband quality; power grid, green policy and sustainability; and data centre risk. Six other policy-related "soft infrastructure" parameters make up the other portion of the CRI: cybersecurity, privacy, government regulatory environment and usage, intellectual property (IP) protection, business sophistication, and freedom of information. There are other factors influencing the development of Cloud Computing in a country; these are the qualitative measures taken by governments to improve the regulatory aspects of the cloud, such as amendments to privacy laws, data control measures, etc. (ACCA, 2016).

Table 2-2 The Cloud Computing Readiness Index 2016

CRI Rank, Country	#01	#02	#03	#04	#05	#06	#07	#08	#09	#10	TOT. SCORE	Rank Change
#1 Hong Kong	8.1	9.1	6.7	8.0	6.2	9.5	7.2	8.6	7.4	7.2	**78.1**	**+4**
#2 Singapore	6.4	9.4	6.5	7.8	6.8	9.0	8.6	8.9	7.3	6.0	**76.7**	**+2**
#3 New Zealand	4.6	8.2	7.6	6.8	7.4	9.0	8.1	8.7	6.9	7.2	**74.4**	**-1**
#4 Australia	4.3	8.0	6.6	6.3	7.6	9.5	7.4	8.3	6.7	8.3	**73.2**	**-1**
#5 Japan	3.9	8.9	6.7	5.9	7.1	8.0	7.8	8.7	8.3	7.8	**73.0**	**-4**
#6 Taiwan	4.1	8.8	6.7	6.4	7.0	9.5	6.7	7.4	7.1	7.2	**71.1**	**+1**
#7 South Korea	3.8	9.0	6.3	6.2	7.1	9.0	7.0	6.0	6.9	6.7	**68.0**	**-1**
#8 Malaysia	3.3	7.6	5.4	5.9	7.6	8.0	7.4	7.7	7.6	5.8	**66.3**	**-**
#9 Philippines	3.3	5.5	6.0	3.5	3.5	7.5	5.5	5.6	6.1	7.3	**53.8**	**+1**
#10 Thailand	3.8	8.6	6.0	5.2	4.1	5.0	5.1	4.6	6.3	3.8	**52.6**	**-1**
#11 Indonesia	1.8	6.3	5.4	2.7	4.7	6.0	5.6	6.1	6.1	5.8	**50.6**	**+1**
#12 India	1.7	5.6	5.1	1.9	7.1	4.5	5.5	6.0	6.0	5.8	**49.1**	**+1**
#13 China	1.6	6.6	5.3	2.5	4.4	5.5	6.2	5.7	6.1	1.3	**45.4**	**-2**
#14 Vietnam	3.0	6.7	5.4	2.6	3.2	5.0	5.4	5.1	5.1	2.4	**44.0**	**-**
Comparison (and hypothetical rank)												
Brazil (#8)	3.8	6.8	7.0	4.4	7.1	5.0	5.2	4.7	6.1	7.0	**57.1**	
Germany (#3)	5.0	8.4	7.1	6.9	7.1	8.0	7.3	8.1	8.1	8.3	**74.3**	
South Africa (#8)	5.0	6.0	5.8	2.7	3.8	3.5	6.0	7.7	6.3	7.4	**54.3**	
UAE (#8)	3.8	8.3	4.9	6.7	3.5	3.5	8.1	7.9	7.6	3.3	**57.5**	
UK (#3)	6.1	8.5	7.2	6.6	7.1	8.5	7.8	8.6	7.9	7.6	**75.7**	
USA (#5)	4.3	8.4	6.6	5.8	8.2	6.5	7.4	8.3	8.0	8.1	**71.6**	

Note: All values to 1 decimal place. #01 International Connectivity, #02 Broadband Quality, #03 Power Grid, Green Policy, and sustainability, #04 Data Centre Risk, #05 Cybersecurity, #06 Privacy, #07 Government Regulatory Environment and Usage, #08 Intellectual Property Protection, #09 Business Sophistication, #10 Freedom of Information.

Source: ACCA (2016)

2.5 Indonesia's SMEs

SMEs are considered collectively as a major economic player and a potential source of national, regional and local economic growth. SMEs contributed more than 50% of 2008 GDP in Indonesia, Japan, Germany and US, also absorbed more than 70% employment in Indonesia, Vietnam, Pakistan, Japan, republic of Korea and Germany (Yoshino and Wignaraja, 2015).

Most countries define SMEs based on their annual revenue and/or number of employees (Dwivedi et al. 2009). For this study, SME is defined based on The Law of Republic Indonesia Government no. 20 year 2008, where an SME is defined as a company with assets less than IDR 10 billion or annual revenue less than IDR 50 billion. See Appendix A1 for the detailed definition.

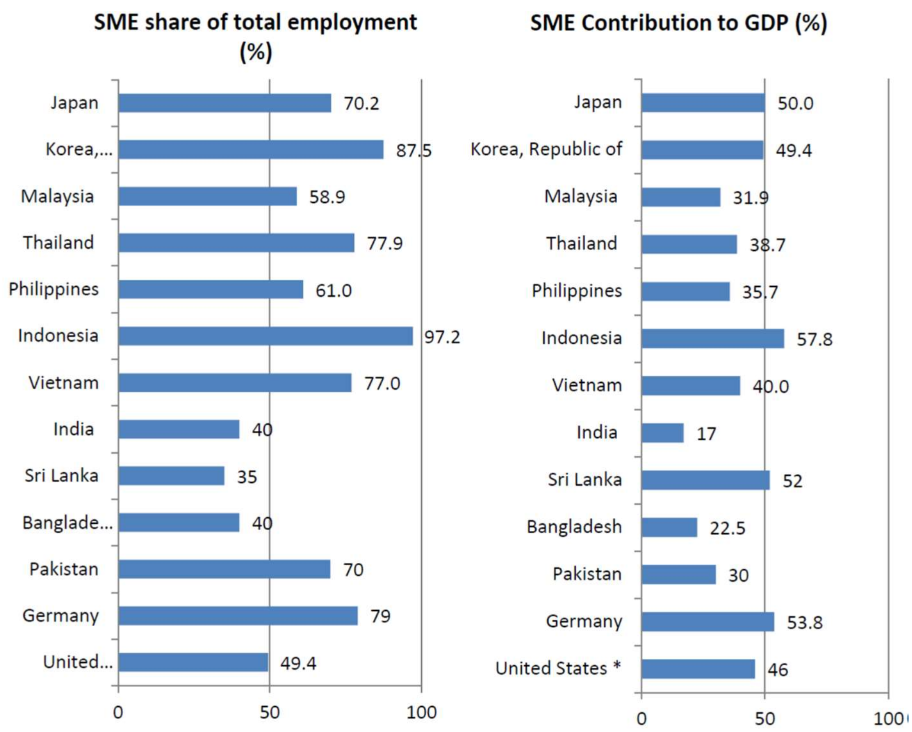

Figure 2-2 SMEs contribution to the National Economic in 2008

Source: Yoshino and Wignaraja, 2015

Approximately 56.5 million SMEs contributed to 59.1 percent of Indonesia's total GDP in 2013, an increase from 56.1 percent in 2003. SMEs have become an important source of Indonesian economic growth and employment and in 2013, 97.2 percent of Indonesian private sector employment was in SMEs, an increase from 96.3 percent in 2003. However, average output growth per SME was less than that achieved by large enterprises. The average annual output per SME increased by only 14.7 percent compared with large enterprises showing a growth of 20.9 percent over the period 2003 to 2013 [BPS, 2003-2013]. Figure 2-3 depicts the total output of Indonesia's SMEs (in million IDR).

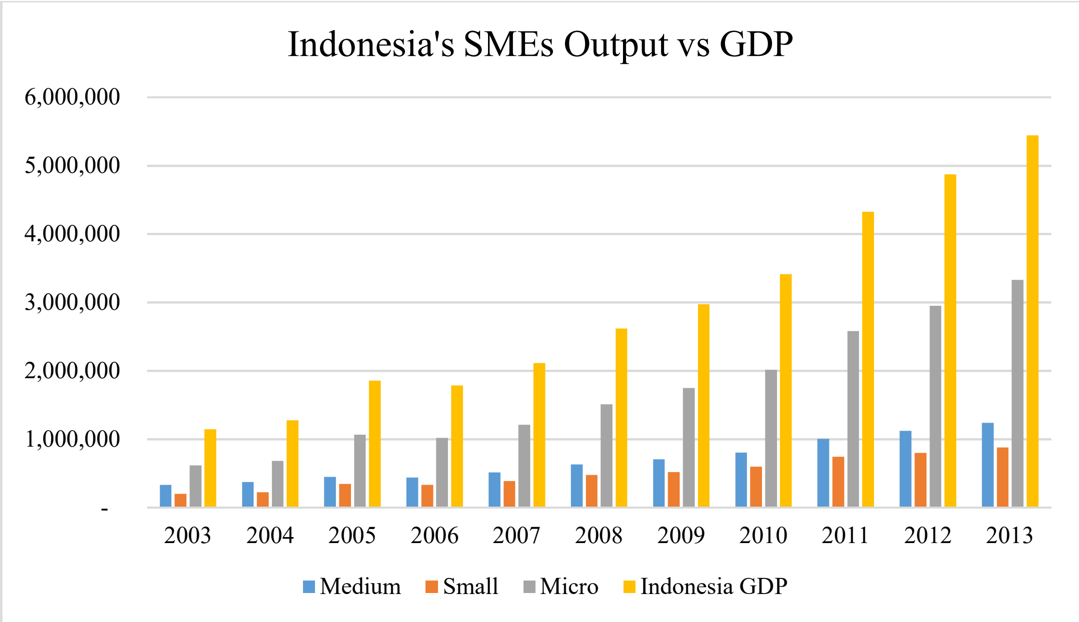

Figure 2-3 Output and GDP of Indonesia's SMEs

Source: BPS (2003-2013)

Micro SMEs contributed the most to Indonesia's GDP in 2013, followed by medium SMEs, then by small SMEs that accounted for 36%, 14% and 10% respectively. In terms of the number of SMEs, micro SMEs accounted for the vast majority of the total SMEs (98%), while small SMEs accounted for about 1% and medium SMEs accounted for about 0.1% of the total number of SMEs in 2013 (BPS, 2003-2013). The figures highlight that SMEs collectively played an important role in the Indonesia economy. However, individually the SMEs struggle to compete, with the average output per SME in 2013 at 0.013% of the average output for a large enterprise and the average output for SME employees at 5% of that found in large enterprises (BPS, 2003-2013).

Tambunan (2009) identifies five characteristics of Indonesian SMEs which make these businesses important for this country's economic development. First, SMEs in Indonesia are mainly owned by local people and employs millions of people throughout the country. Second, SMEs are very common in rural areas, and since their businesses are based on agriculture, they have become important for rural economic development. Third, SMEs are labour-intensive, with many young and less-educated staff members involved in the business. Fourth, Indoensian SME owners use their personal savings to finance business operations. Fifth, the businesses often produce simple consumer goods, serving the domestic market and targeting low-income consumers.

The Indonesian MCSME recognized the problems that have to be overcome by SMEs in order for them to grow within the ASEAN Economic Community (AEC). Many of the problems found are legacy issues that have never been adequately resolved, such as human resources competence, legality of ownership, finance and marketing (Dekop, 2015). Most of the Indonesian SMEs are owner-managed and operated, and this reduces the opportunity for training as this would effectively close the business during the training period (Tambunan, 2008). The average education level of SME owner/operators is high school level, although an increasing number have a tertiary qualification (Anton et al., 2015). However, Basyith et al. (2014) found that the education level of managers or owner-managers had no significant impact on firm performance.

SMEs also have limited access to financial services, such as access to credit, equity and payment services. The lack of access to finance and financial services restricts their growth when they need additional capital to develop their business, and payment transactions are also less secure and cost more (World Bank, 2015).

According to Tambunan (2009), Indonesian SMEs can improve their competitiveness through three key avenues: (1) human resources, (2) working capital, (3) management and technological skills. Another study conducted by Anton et al. (2015) of 590 Indonesian SMEs found that human capital also plays a significant role in SME development. Furthermore, SMEs need to strengthen their working capital, innovation and business strategy in order to improve their performance (Anton et al., 2015).

An observation study of 2,800 SMEs in Indonesia revealed that the gender of managers does not significantly affect the short-term business performance; however, for long-term business performance, female management is significantly better than male management (Basyith et al. 2014). The type of industry in which an SME is engaged has no significant impact on performance. However, firm size is important. If big businesses have loans, this can have a negative impact on performance. On the other hand, if larger SMEs have stable capital and earnings, an additional loan could become a burden if additional revenue sources cannot be found. The majority of larger SMEs do not acquire their income from one source and are often present in more than one business centre (Basyith et al., 2014).

Table 2-3 Assistance Programs to Strengthen Small-Micro Business in Indonesia (1997-2003)

Institutions	Number of Institutions	Number of Assistance Program
Government	13	388
Banking	7	31
Private Companies	10	12
Donor Agencies	8	46
NGOs	20	109
Others	6	8
Total	64	594

Source: Smeru (2004)

The Indonesian government has realised the importance of the role of SMEs in the nation's economy. Through the MCSME, the Indonesian government has set up and run strategic programs to empower SMEs. The programs include entrepreneurship training, facilitating working capital, and providing marketing facilities (www.dekop.go.id, 2017). The government also encourages the private sector, including the State-Owned Enterprises (SOEs), to provide funding and assistance for SMEs. Table 2-3 presents a number of the micro and small enterprise assistance programs during 1997 to 2003, many of which are similar to that found today. The assistance programs cover capital assistance, training, facilitation, information, business facilities, promotion, disseminations, guidelines, and others (SMERU, 2004).

2.6 SME ICT Adoption

ICT is one of the key growth engines for SMEs, in terms of facilitating business processes, even though the adoption of ICT by SMEs is not occurring as fast as one would expect, especially in developing countries. Kartiwi and MacGregor (2010), when comparing Indonesian and Australian SME perceptions of barriers to e-commerce adoption, found that all ten barriers to the adoption of e-commerce gathered from several studies and references, were applicable, and no additional barriers were perceived for the near future, both in Indonesia and Australia. The ten perceived barriers are: (1) not suited to the products/services, (2) not suited to the way of doing business, (3) not suited to the clients' (customers and/or suppliers) way of doing their business, (4) not offering any advantages to the organisation, (5) not having the technical knowledge in the organisation to implement e-commerce, (6) too complicated to implement, (7) not secure, (8) implementation cost is too high, (9) not having the time to implement (10) difficult to choose the most suitable e-commerce standards with so many different options available.

Voice and Internet services are regarded as legacy services, although they become powerful services if embedded in Cloud Computing services. Colombo et al., 2013, in their study of the adoption of broadband Internet technology by SMEs concluded that the impact of broadband connectivity itself for SMEs is negligible; conversely, it was found to be of benefit if combined with the appropriate broadband applications services such as Cloud Computing services.

The following studies provide empirical evidence of how ICT affects SMEs. Investment in ICT, consisting of a broadband Internet connection and complementary broadband application, is a factor affecting outputs, especially for the SMEs, because it offers an efficient and permanent connectivity to the global market, at a price that many SMEs can afford (Colombo et al. 2013). Luchetti and Sterlacchini (2004) found that worker education levels determined SME adoption of market-oriented ICT. The penetration of general-use ICT is not linked to any specific feature of the SMEs. The adoption of production-integrating ICT depends instead on the business size, the extent of their productive linkages with other businesses, the use of advanced information technologies in their production processes, and the educational level of the labour force.

Santosa and Kusumawardani (2010) reported that the deployment of the Industrial Attachment Program (IAP), an internship program for engineering students who have acquired certain computer engineering certifications conducted by the Cisco Networking Academy, in several SME in Central Java and Jogjakarta, is very beneficial for the host SMEs. It was found that SMEs became more confident about adopting ICT after the internship program. However, it was concluded that the utilisation of ICT by Indonesian SMEs has not been optimal. Two obstacles that cause this situation are:

1. Most of the SMEs still use manual procedures to record most of the activities; therefore, they consume more time and resources when retrieving important data;
2. A few SMEs use low cost communication methods with their customers, such as email.

Chibelushi and Costello (2009) studied the challenges of ICT implementation in Italian SMEs and found the factors causing problems faced by SMEs, regarding the implementation of ICT, are: the level of education of SMEs' top management, lack of strategy and perceived benefits of adopting new technologies, ICT investment cost, and incompetent management skills. Another study found that individual characteristics of the cellular telephone users (gender, age, income and occupation) had no significant impact on user perceptions of cellular telephones (Kwon and Chidambaram, 2000). Meanwhile, a study that applied the TOE[4] model to investigate the critical determinants of e-market adoption by Australian SMEs shows that top management determine the e-market implementation (Duan et al., 2012).

SME knowledge and awareness of Cloud Computing are very low. Tutunea (2014) found that, of 1,266 SMEs in Romania's North-West development region, 60.87% were unaware of this technology and less than 7.43% had an above average knowledge of Cloud Computing solutions. SMEs that have no ICT (non-ICT SMEs) are better placed to implement Cloud Computing than those SMEs that already have good in-house ICT. Non-ICT SMEs can maximise the benefit of low upfront cost of the Cloud Computing implementation. However, SMEs that already use in-house ICT incur an extra cost for a new or larger Internet connection if they want to migrate from on-premise systems to SaaS (Roos and Blumenstein, 2015). However, the benefit of obtaining the latest software update and technical support must be considered when calculating the cost-benefit ratio of the in-house software replacement with the SaaS, since it may be cheaper than the Internet cost. In addition, the pay-on-demand business model can be one solution to overcome the "additional cost" challenge (Roos and Blumenstein, 2015).

Furthermore, according to the survey of 23 SMEs in Bandung, Indonesian SMEs are ready to implement Cloud Computing in terms of the following readiness aspects: (1) have at least one employee with computer skills, (2) willingness to pay a monthly fee for ICT, and (3) awareness of ICT as one of the major needs of the business and include it in a business strategy. Nonetheless, they require appropriate training and role models that can be used as an example (Surendro and Fardani, 2014). Similar results were obtained from a survey of 47 SMEs in the

[4] *See section 2.10*

city of Czestochowa in Poland where 100% of these SMEs were using SaaS, but only a few were using IaaS and PaaS (Bajdor and Lis, 2014).

According to a study conducted by Mohabbattalab et al., (2014) which applied the TAM[5] to 410 Malaysian SMEs, the respondents believed that Cloud Computing had the following advantages over traditional computing: (1) scalability, (2) better security, (3) flexibility, (4) reliability, (5) meeting needs of the organization, and (6) cost effectiveness. Scalability had the highest average mean, followed by security. Malaysian SMEs believed that Cloud Computing is more secure than a traditional IT platform. The third aspect is flexibility. SMEs value Cloud Computing for its mobile and more collaborative environment. Lastly, the issue of cost is another reason for adopting Cloud Computing. Malaysian SMEs still doubt about Cloud Computing can obviate substantial investment in equipment, programming and skilled professionals.

According to 180 Indonesian firms, the cloud is an attractive option as it meets the organizational needs, and is cost effective, secure and reliable (Dachyar and Prasetya, 2012). Senior management believe that adopting cloud computing services is beneficial. They also understand that the Cloud Computing maintenance cost is lower than the maintenance cost for in-house ICT. In terms of security and reliability, they are certain that Cloud Computing is more secure and reliable than in-house ICT. Cloud-based technologies support collaborative international ventures by linking SMEs and start-up firms to potential partners and venture capital via Internet-based crowd-funding sites (Roos and Blumenstein, 2015).

Luchetti and Sterlacchini (2004) found that worker education levels determined SME adoption of market-oriented ICT. The penetration of general-use ICT is not linked to any specific feature of the SMEs. The adoption of production-integrating ICT depends instead on

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[5] *See section 2.10*

the firms' size, the extent of their productive linkages with other firms, the use of advanced information technologies in their production processes, and the educational level of their labour force.

Erisman (2013) in her investigation of the SaaS adoption factors on Indonesian manufacturing SMEs found that business size, education of middle to top management, and industry sector positively influence the adoption of ICT by SMEs. In addition, the findings concerning SaaS adoption indicate that relative advantage, complexity, and compatibility are the strongest factors influencing the adoption of SaaS. This study applied the TOE model, taking the technological, organisational and environmental factors into consideration. From the technology perspective, the factors were: relative advantage, complexity, compatibility, cost, and risk. Organisational factors were the business size, turn-over asset, technology readiness, senior management support and the education level of senior management. In terms of the environment, the factors were: industry sector, competitive pressure, partner pressure, external support and marketing strategy. The study obtained data from 104 manufacturing SMEs in West Java, Indonesia.

Several previous studies on the adoption of Cloud Computing by SMEs, summarised by Trinh et al. (2015), also confirmed that business size is a significant factor in SME adoption of Cloud Computing (Low at al., 2011; Alshamila et al., 2013; Olivera et al., 2014). Conversely, other studies of cloud Computing adoption by SMEs (Wu et al., 2013, Borgan et al., 2013, Morgan and Conboy, 2013, Hsu et al., 2014, Lian et al, 2014, Seethamraju, 2014), found that business size is not a significant factor. In terms of senior management support, studies found that it significantly affects the Cloud Computing adoption by SMEs (Low at al., 2011, Borgan et al., 2013, Seethamraju, 2014, Alshamila et al., 2013; Olivera et al., 2014). However, several studies found that this factor is not significant (Wu et al., 2013; Morgan and Conboy, 2013; Hsu et al., 2014).

2.7 The Growth Theory

A country's development or growth is multi-dimensional and there are several theories explaining the factors affecting national growth. One of the well-known growth measurements is the United Nations Development Program's Human Development Index (HDI), which measure the growth from multiple dimensions: long and healthy life (life expectancy at birth indicator), knowledge (mean years of schooling indicator and expected years of schooling indicator) and a decent standard of living (GNI per capita indicator). Various studies have sought to understand economic growth through growth models or theories that can be categorised as either: (1) traditional growth theory that is the starting point of all almost growth analysis, or (2) new growth theory.

2.7.1 Traditional Growth Theory

The Solow growth model explained that at any one time, the economy has some amounts of capital (K), labour (L) and knowledge (A) to produce the output (Y) (Romer D.,2012). Capital and labour are exogenous factors, while knowledge is an endogenous factor. This model is considered as traditional or old theory, as it sees productivity growth as an exogenous process, while the new growth theory involves micro-based behavioural functions and endogenous productivity growth (Scarth, 2014).

The Solow growth model equation is:

$$Y(t) = F(K(t), A(t)L(t)) \tag{2-1}$$

This model assumes a constant return, where production function has constant returns to scale in its two arguments, capital and effective labour. This means that if K and L are doubled, while A stays fixed, the output Y will be double too. If c is constant and $c \geq 0$, then:

$$F(cK, cAL) = cF(K, AL) \tag{2-2}$$

The argumentations of the constant returns are: (1) the economy is big enough, that the gain from specialization has been exhausted), and (2) inputs other than capital, labour and knowledge are relatively unimportant.

To determine the behaviour of the economy, the model explains that the rate of change of the capital stock per unit of effective labour k is the difference between (1) the actual investment per unit of effective labour *sf(k)*, output per unit of effective labour *f(k)* and the fraction of that output that is invested; and (2) the investment breakeven or the amount of investment that must be made just to keep k at its existing level $(n+g+\delta)k$. The equation is:

$$\dot{k}(t) = sf\big(k(t)\big) - (n + g + \delta)k(t) \tag{2-3}$$

The Solow model identifies two possible sources of variation, (1) differences in capital per worker (K/L), and (2) differences in the effectiveness of A. However, the differences in capital accumulation cannot account for large differences in incomes.

The Solow growth accounting model $Y(t) = F(K(t), A(t)L(t)$ works as follows:

$$\frac{\dot{Y}(t)}{Y(t)} = \alpha_K(t)\frac{\dot{K}(t)}{K(t)} + \alpha_L(t)\frac{\dot{L}(t)}{L(t)} + R(t) \tag{2-4}$$

$$R(t) \equiv \frac{A(t)}{Y(t)}\frac{\partial Y(t)}{\partial A(t)}\frac{\dot{A}(t)}{A(t)}$$

where $\alpha_K(t)$ and $\alpha_L(t)$ are the elasticity of output with respect to capital and labour at a time respectively. The growth rates of Y, K and L are straight forward to measure, while R(t) can be measured as residual. The Solow residual can be interpreted as a measure of the contribution of technological progress. This model examines only the short-run determinants of growth such as how factor accumulation, improvements in the quality of inputs to growth while ignoring the factors that cause the changes in those determinants (Romer, 2012).

2.7.2 New Growth Theory

New growth theory considers the accumulation of knowledge (A) as an endogenous factor. This model assumes a largely standard production function in which capital, labour and technology are combined to produce improvements in technology in a deterministic way. The variables considered in this model are labour (L), capital (K), technology (A) and output (Y).

A production model, Harrod –Dommar model, explains that real output (Y) is constructed from the function of Technology (A), Composite Capital (K) and Labour (L):

$$Y = F(A, K, L) \tag{2-5}$$

Several studies have been conducted to improve the theory known as The New Growth Theory. Foss (1998), for instance, concluded that A is no longer a constant, and Y is defined as a function of A , K, L, H, where H is human capital.

$$Y = F(A, K, L, H) \tag{2-6}$$

A is interpreted as consisting of the stock of designs for producer goods. It is a non-rival factor of production, for the reason that these designs can be used over and over again at no additional cost. The study of A as a factor affecting the productivity evolves, as discussed in more detail in Section 2.7.4.

The new growth theory (P. Romer, 1990; and Aghion and Howitt, 1992) takes the following form:

$$Y(t) = [(1 - a_K)K(t)]^{\alpha}[A(t)(1 - a_L)L(t)]^{(1-\alpha)}, 0 < \alpha < 1 \tag{2-7}$$

The production of new ideas depends on the quantities of capital and labour engaged in research and on the level of technology. The generalised Cobb-Douglass production function is written as:

$$\dot{A}(t) = B[a_K K(t)]^{\beta}[a_L L(t)]^{\gamma} A(t)^{\theta}, B > 0, \beta \geq 0, \gamma \geq 0 \tag{2-8}$$

where θ reflects the effect of the existing knowledge on the success of R&D. The production function for knowledge is not assumed to have constant returns due to the scale of capital and labour.

This model includes the determinants of long-run growth in which four parameters affect the economy's growth rate: (1) when individuals are less patient, fewer workers engage in R&D and so growth is lower; (2) increase in substitutability among inputs also reduces growth; (3) a productivity increase in the R&D sector creates an increase in growth; and (4) an increase in population size (L) increases the long run growth (Romer D. 2012).

Sengupta (2011) also mentioned that ICT and productivity are important sources of economic growth. As a new technology, ICT involves improvement in the productivity of knowledge and research and development (R & D) otherwise known as 'knowledge capital'. The 'new knowledge economy' is an economy stimulated by new technology, and has four fundamental characteristics.

1. It adopts knowledge capital, such as: software development, new design and blue print, R&D activity, skill in the use of human capital such as learning.
2. It improves competitive efficiency, improving profitability using market process which entrepreneurs trade in technology license and knowledge.
3. It engages in global trade to expand export.
4. It creates knowledge capital through collaboration and mergers, and improved ICT contributions to economic growth.

The impact of ICT on economic growth is not straight forward since several complementary factors can influence the extent of the impact of investment in ICT on economic growth. One of these factors is the amount and quality of available human capital that has a linear correlation with productivity.

2.7.3 The Production Function

The Production Function originated as a microeconomics concept that has been adopted by macroeconomists to explain the relationship between inputs and outputs of the whole economy. The aggregate production function is a simplification of complex production processes of the various forms that is commonly expressed using the following equation:

$$Y = A\,F(L, K) \text{ or } Y = F(L, K; t) \tag{2-9}$$

where Y is the maximum output, A is the level of technology, L is employment and K is capital. A is not independently measurable and is often recognised as the Total Factor Productivity (TFP), and in time series analysis, it is often proxied by time (Felipe and McCombie, 2013).

The Cobb-Douglas (1930) production function is the most widely-used of production function in econometrics. In 1930, Charles W. Cobb and Paul H. Douglas proposed it after investigating how to estimate the output of American manufacturing from 1899 to 1922 and different industries in the world. Hence, it is used as a general universal law of production. The Cobb-Douglas production function with an additive error term can be represented as:

$$Y_t = AL_t^{\beta}K_t^{\alpha} + \upsilon_t \tag{2-10}$$

where, Y_t is the output at time *t* (commonly represented by GDP); L_t is the Labor input; K_t is the Capital input; A is a constant; υ_t is the random error term. β and α are positive parameters. There are three possible conditions of the α and β values. First, when α is equal to $(1-\beta)$ or $(\alpha+\beta) = 1$, this condition indicates a constant return indicating efficient production. An economic benefit increase will be achieved by improving the technical level, not through the expansion and improvement of the scale of production. Second, if $(\alpha + \beta) > 1$, it is known as increasing returns. Increasing economic benefits will be obtained through increased input with the existing technology and with the expansion of production scale. The third is called diminishing returns, when$(\alpha + \beta) < 1$. Increasing the output should be achieved by expanding production scale using the existing technology.

Following Hossain et al (2012), the transformation log form of the Cobb-Douglass production function equation is:

$$ln(Y_t) = \ln(A) + \beta \ln(K_t) + \alpha \ln(L_t) + e_t \quad (2\text{-}11)$$

where, e_t is equal to $\ln(v_{t)},$ and treated as an additive random error with a zero mean. In this form, the function is a single equation which is linear for the unknown parameters: A, β and α.

Many researchers often use A as the representative TFP; therefore, it is often unknown and not easily measured. Dummies are used in the cross-sectional data or a non-linear time trend is used in the time series data. In the neoclassical economies, TFP is a function of wage and profit, and is therefore often used to differentiate the level of technology infusion between countries (Felipe and McCombie, 2013).

The growth accounting model is developed based on the neoclassical framework that originated with the work of Solow (1957). The objective of growth accounting is to describe how output which reflects the economic growth is created by different inputs.

The Solowian production function is formulated as:

$$Y = A e^{\mu_t} K^{\alpha} L^{(1-\alpha)} \quad (2\text{-}12)$$

Where Y is representing GDP, A is constant that represents the technological starting position of the relevant economy, K is the stock of capital (physical and human), L is labour productivity, e^{μ} represents the technology exogenous rate, and α represents the percentage increase in gross national product from a 1% increase in capital (Foss N.J, 1998).

An important assumption of Solow's growth model is that countries have identical technologies, in this situation A can be asssumed as constant (Felipe and McCombie, 2013).

2.7.4 Total Factor Productivity

A in the production function equation can represent the level of technology or TFP and also is often proxied by time in time series data. Several recent studies have considered A as knowledge or R&D, but it still does not have a strong argument (Felipe and McCombie, 2013). A is sometimes known as the Hicks-neutral shift parameter (Goodridge, 2007). In practice, TFP is not only associated with technology change, but also with some of the quality change associated with labour and capital. TFP is not independently measurable and so one problem is not correctly specified in the empirical analysis. In cross-sectional data, it has to be proxied by the use of dummies, while in time series data a linear or non-linear time trend is used (Goodridge, 2007).

In the general form of an aggregate production function with exogenous technical change, the rate of technical progress that may vary temporarily is symbolised by λ. The equation is:

$$V = F(L, K, t) \tag{2-13}$$

and in growth rate form:

$$V_t = \lambda_t + \alpha_t L_t + \beta K_t \tag{2-14}$$

where V, L and K are output, the labour input and the constant price value of the capital stock respectively. α and β are the output elasticities that may change overtime.

Solow's growth model assumed that countries have identical technology, which means that in cross-sectional data, A can be omitted. However, several studies argued that it cannot account for the large observed variations among countries, specifically in TFP, because it assumes that countries have identical technologies (Prescott, 1998; Islam, 1999). Felipe and McCombie (2013) concluded that TFP is needed to explain the observed large income differences between countries. However, it is not possible to calculate the technical change (the TFP growth) and the growth factor inputs contribution to economic growth separately, as an appropriate aggregate production function does not exist.

Several empirical studies have investigated and calculated the value of TFP. Ilmakunnas and Miyakoshi (2013) defined TFP as the share of output that is not explained by inputs. In their examination of the drivers of TFP in the aging economy, they found that the aging of the labour input and ICT content in the capital input are drivers of TFP. Goodridge (2007) analysed the UK's TFP for the period from 1975 to 2005. Jalava and Pohjola (2007) calculated TFP growth in ICT production (ΔA_{ICT}) as the negative of the ICT output price change relative to the share weighted price change of labour and capital.

The OECD database and the US Bureau of Labour Statistics (BLS) calculates the TFP growth (or Multi Factor Productivity growth) periodically. Goodridge (2007) used quality-adjusted labour input (QALI) and the volume index of capital services (VICS) experimental method to measure TFP by measuring the gross value added (GVA) to decompose output growth into the contributions of growth in inputs and growth in the residuals. Matambalya and Wolf (2001) assumed TFP to be affected by other variables such as skill intensity of labour, export orientation, and also the use of ICT equipment as well as sector and country dummies.

From their study which used U.S. data from 1987-2004, Basu and Fernald (2007) found that the use of ICT throughout the economy increases capital which boosts labour productivity in ICT-using sectors, but does not change the TFP in sectors that only use but do not produce ICT. TFP growth in producing ICT goods shows up directly in the economy's aggregate TFP growth.

2.8 Empirical studies of the Aggregate Production Function

The long evolution of the aggregate production function, since it was introduced in the early 1900s, has produced a plethora of studies on economic growth as well as other related studies. The following sections explain several studies of the aggregate production function on economic growth and other areas that are relevant to this research.

2.8.1 Empirical Studies of the Aggregate Production Function on ICT, SME and Economic Growth

2.8.1.1 Developed Countries

Several studies have examined the association between ICT and economic growth by applying the aggregate production function at the country level as well as comparing several countries worldwide. Most studies have been carried out for developed countries, especially OECD countries. A country-level study by Jalavaa and Pohjola (2007), for instance, used a growth accounting methodology to measure the contribution of ICT (as component of aggregate ouput and input) to Finland's economic growth from 1995 to 2005. They found that ICT accounted for 1.87 percentage points of the observed labour productivity growth at an average rate of 2.87 percent and the contribution from increases in ICTcapital intensity was 0.46 percent. Another country-level study by Ketteni (2011), used the general production function to explore the interaction and influence of ICT on the output elasticity of human capital and vice versa in the U.S. The findings indicate that countries with high levels of ICT capital have high output elasticity of human capital. In addition, countries with high levels of human capital have high output elasticity of ICT, a result suggesting the two are complementary. Jorgenson and Stiroh (2003) also studied the U.S. data using production function theory to determine whether IT capital has substituted for other capital and labour input in the U.S. economy during the IT evolution from 1948 to 1996. The result shows that lower computer prices drove IT capital as a substitute for other capital and labour input during the period from 1990 to1996.

The increase in ICT usage and the availability of historical data in developed countries has motivated researchers to apply the production function theory in their studies to investigate the role of ICT in economic growth. Several studies on the OECD and other developed countries (such as, Ilmakunnas and Miyakoshi, 2013; Ceccobelli et al., 2012; Samoilenko and Osei-Bryson, 2008; Marco Vicenzi, 2012; Dimelis and Papaioannou, 2012) found that ICT plays a significant role in growing economies. However, in Japan, the long-term coefficient estimate for ICT investment is statistically insignificant in increasing GDP (Ishida, 2015).

Similarly, no evidence was found that, from 1980 to 1995, the increase in ICT capital was statistically significant in terms of increasing labour productivity in developed countries (Zelenyuk, 2014). The study examined the impact of ICT capital on the labour productivity distribution of 15 developed countries from 1980 to1995. It considers the impact of three sources: (i) change in ICT-capital per unit of labour, (ii) change in non-ICT-capital per unit of labour, and (iii) change in other factors generally attributed to changes in TFP. There was no evidence that, from 1980 to 1995, an increase in ICT capital was a statistically significant force for change in the distribution of labour productivity of the developed countries.

In the U.S., the substantial deceleration of growth during the Great Recession (2005 to 2010) was driven by modestly negative aggregate productivity growth, although only a minor portion of the drop in the growth rate was due to the IT-producing industries (Jorgenson and Vu, 2016).

Apart from the specific-country and worldwide-level studies, some researchers also applied production function theory to analyse the impact of ICT on company-level productivity. One such study is that of Colombo et al. (2013) who examined the impact of broadband Internet technology on the productivity performance of 799 SMEs in Italy from 1998 to 2004. Interestingly, they concluded from their findings that the impact of basic broadband applications adoption in SMEs is negligible, although SMEs benefit from adopting advanced broadband applications depending on the industry sector.

Most of the studies have considered ICT in the context of an in-house ICT service model that includes infrastructure, hardware, software and telecommunication equipment. However, Djiofak-Zebaze and Keck (2009) defined ICT as mobile, locally fixed, and international communication. An outsource service model of ICT services was also investigated by Colombo et al. (2013), where ICT services capital is defined as a broadband Internet connection and 15 broadband service applications, such as virtual private networks (VPNs), data disaster recovery, and local protection systems.

Digitalization through access to ICT, the ability to use the ICT and digital empowerment, may drive productivity and employment growth. Moreover, inclusive policies may effectively help to bridge the gap between the population’s most privileged and the disadvantaged (Evangelista et al., 2014). The access dimension of ICT has no effect on per capita GDP, labour productivity and employment (with the only exception of employment in services where it has a positive impact). ICT empowerment matters in terms of per capita GDP and job creation (aggregate and in the two macro sectors of manufacturing and services), but not for labour productivity. Finally, the findings of a positive impact of ICT usage on labour productivity are confirmed only when allowing for a one period lag in the ICT indicators. ICT empowerment is important not only for increasing the overall level of employment in the economy, but (and more importantly) for allowing women and the long-term unemployed to get a job. The study covers 27 EU countries during the period from 2004 to 2008.

The ICT capital investment coefficient estimates reflect the expected positive signs which are statistically significant for the high-income group, upper-middle income group, and all income groups combined. The magnitudes of the estimated coefficients range from the lowest 0.22 (for the high-income group) to the highest 0.35 (for the upper-middle income group) with a value of 0.22 for all of the income groups combined. The important highlights of the results are as follows: (1) the magnitude of the NICT and ICT capital investment coefficient estimates are almost identical for all of the income groups combined (Youssef et al., 2011). Investment in ICT, especially NICT capital in the upper-middle income group, is doing very well compared with the high-income group. This might have to do with the stage of development and relatively lower level of capital stock in this group of countries.

2.8.1.2 Developing Countries

Although not as many as in developed countries, studies of the role of ICT in economic growth have also been conducted in Africa and Asia. Djiofak-Zebaze and Keck (2009), for instance, investigated the impact of WTO commitments and unilateral reform on telecommunication sector performance and economic growth in 32 African countries from 1997 to 2003. Also, Ridzuan and Ahmed (2013) studied the impact of ICT investment on economic growth in eight Asian countries from 1975 to 2006. Their studies also concluded that ICT is positively related to economic growth.

The studies conducted by Kuppusamy et al. (2008); and Matambalaya and Wolf (2001) also investigated the influence of ICT on the economies of developing countries. Implementing the co-integration technique, Kuppusamy et al. (2008) tested the hypothesis that ICT-based investment has paid off for Australia and the ASEAN-5 countries (Malaysia, Singapore, Indonesia, Thailand and the Philippines) between 1992 and 2006. The findings suggested that

ICT investment has had a positive and significant long-term relationship with economic growth in Australia, Malaysia and Singapore. However, in Indonesia, the Philippines and Thailand, ICT investment did not contribute significantly to economic growth during the same period.

Matambalaya and Wolf (2001) applied the Cobb-Douglass production function to examine the impact of ICT on SMEs in Kenya and Tanzania, using empirical evidence from November 1999 to December 2000. Their findings indicated that investment in ICT is a negative in all of the regressions carried out but it is never significant. The empirical evidence also showed that the role of ICT is not sector-specific but can be generalised to the whole economy. However, in India, ICT contributed significantly to aggregate productivity growth. India's export-oriented ICT sector has helped to improve the efficiency of its fast-growing service economy (Erumban and Das, 2016).

Thompson and Garbacz (2007) explored the impact of communication networks and economic reform on economies, using a panel of 93 developd and developing countries for the period covering 1995 to 2003 (2004 for Asia). The study found that institutional reforms and the growth in information networks appear to benefit the world as a whole, but particularly its poorest nations, by improving the efficiency of how these and other resources are used. Education is an important factor in shifting the production frontier out of Asia.

However, another study produced different results, where upper-income developing countries have achieved positive and significant productivity gains from in-house IT investment (including spending on personal computers and other peripherals) in the more recent period as they have increased their IT capital stocks and gained experience with the use of in-house IT. The effect of in-house IT on productivity is extending from the richest countries to a large group of developing countries. The policy implication is that lower-tier developing countries can also expect productivity gains from in-house IT investments (Dedrick et al., 2013). This study utilized data on in-house IT investment and productivity for 45 countries, comprising 19 developing and 26 developed countries, from 1994 to 2007, and compared the results with those from an earlier study (data from 1985 to 1993). This study also examined the role of ICT infrastructure on the utilisation of in-house ICT, and found a significant negative interaction between the cost of communications and IT capital for developing countries, but not for developed countries or the full sample. In other words, higher telecommunications costs lowers the payoff from IT capital in developing countries. Cellular penetration was positive and significant for the developed countries, but not for the developing countries. But when testing the difference between the coefficients of developed and developing countries, there was no statistically significant indication that Internet penetration was positive and significant for the full sample, but was not significant when developing or developed countries were examined separately. Considering the overall pattern, it appeared that widespread diffusion and lower communications costs and network technologies helped to boost the impact of IT capital, albeit to a different degree in developed and developing countries.

In Latin America, total capital is the main source of economic and productivity growth, while the role of ICT is less than one sixth of the total capital contribution. However, total capital went hand -in-hand with high investment, especially in ICT. Moreover, ICT capital is strongly related to the improvement of human capital. Although the contribution of ICT capital is very low compared to the heterogeneous non-ICT capital contribution, it has a positive impact on all sectors of economic activity. The highest contribution is in the service sector, while agriculture and construction are those with the lowest contributions. This result supports the finding that ICT capital is the factor that makes the least contribution to the increase in labour productivity in the economies of the region, both in terms of the total economy and by activity sector (Hofman et al., 2016).

Lee and Brahmasrene (2014) examined the long-run equilibrium relationship and the short-run relationships among ICT, carbon dioxide (CO_2) emissions and economic growth for nine members from ASEAN, from 1991 to 2009. This study found that ICT shows significant to highly significant positive effects on economic growth with a highly significant level of 0.01. In addition, ICT development throughout ASEAN member countries has been prompted by several other factors such as high growth of human capital and structural changes to the economies. The inverse bidirectional relationship at varying levels indicates that the relationship may be determined by various factors such as the degree of dependence on the ICT sector, the specific conditions of ICT development and its association with CO2 emissions. Therefore, the levels of economic growth and ICT development in each country may be considered individually as important determinants.

Several studies also examined the association between ICT capital and human capital, and found that these had a positive relationship. Turen et al. (2016) found that ICT diffusion and a more economically stable environment can increase the Human Development Level (HDL). The study investigated the effects of ICT and Economic Freedom Level (EFL) on countries' HDL, based on panel data of 118 countries covering the period from 2000 to 2011.

ICT increased the amount of information produced, stored, distributed and shared. Therefore, knowledge development and sharing also increased. The power of freely-available knowledge can increase not only the efficiency of education and training processes, but also the competitive edge, through efficiency and productivity at both micro and macro levels, leading to GDP growth. Moreover, ICT can improve the quality of health services, and overall, the health of the whole population. In the long run, a better education system, better qualified health professionals and an increase in the efficiency and productivity of other sectors may increase the interrelated HDL dimensions, which measure the throughputs of national health, education systems and average income.

In the context of developing economies, ICT is a communication and collaboration enabling tool that may counterbalance the lack of other resources (Roztocki & Weistroffer, 2008). Qureshi (2005) proposed a model exploring the role of ICT in national development processes. Her model suggested that ICT implementations contribute to development by providing: better access to information and expertise; increased competitiveness and access to new markets including global markets; administrative efficiencies from low transaction costs; an increase in labour productivity through learning; and by directly reducing poverty. For the last three decades, the significant role of ICT related to HDL in terms of economic growth and productivity in a number of developed, developing and transitional economies was emphasized in an immense volume of literature (Jorgenson and Vu, 2016). See Jorgenson and Stiroh (2003) for macro level; Sapprasert (2006) for industry level; OECD (2003, 2004) and Pilat (2004) for the micro level. For the positive impact of ICT on the health care industry, see Kshetri (2013), Mahmud et al. (2013), Lluch and Abadie (2013). For the ICT role in the struggle to reduce poverty, see Weber(2012), Diga et al. (2013). For the ICT contribution to education, see Vinluan (2011) and Al-Khasawneh et al. (2013).

Studies have found that ICT plays a major role in the growth of high and upper-middle income groups, but does not contribute to the growth of the lower-middle income group countries. These findings suggest that the level of investment in ICT is not the cause of slow growth in lower-middle developing countries as previously thought (Youssef et al., 2011). The study examined whether, and to what extent, information and communication technology (ICT) has helped to improve economic growth. It adopted the traditional growth model as a framework to estimate contributions of labour, ICT, and non-ICT capital to economic growth in developed and developing countries. The estimates of the growth model by using time-series cross-country data of a total of 62 countries for the period from 2000 to 2006 reveal that the effect of ICT on economic growth differs across different income groups of countries.

2.8.2 Empirical studies of Sectoral Production Function

Apart from being used to model the aggregate output of the entire economy, the Cobb-Douglass production function has been used to examine productivity in specific sectors. Enaami et al. (2013), for instance, used the Cobb-Douglass production function in agriculture sector to investigate the relationship between crop output and factors influencing the crop output such as water, seeds, chemical fertilizer, etc., in Thailand. The Cobb-Douglass production function has been used to examine two basic business process change paradigms on the business value generated for firms by their information and communication technologies (ICT) investment. This study explored data from 271 Greek Firms (Loukis et al, 2009). The production function was also used by Smyth (1993) and Werf (2008) for the energy sector. Smyth (1993) used the aggregate production function to test the hypothesis that the effects of increases and decreases in relative energy prices on output were symmetrical, using U.S. data from 1952 to 1990, with the results showing that the relationship between relative energy prices and output is highly asymmetrical. Werf (2008) used the Cobb Douglass Production Function to estimate the parameters of two-level constant elasticity of substitution (CES) production functions with capital, labour and energy as inputs, from 12 OECD countries. Pendharkar et al. (2008) investigated 1238 software projects to determine whether software development efforts reflected the Cobb–Douglas functional model with respect to team size and software size, and whether the hypothesized Cobb–Douglas function, for software development efforts with respect to team size and software size, is valid. The aggregate production function was used by Uri (1998) in the financial sector to investigate the embodied and dis-embodied technical affects on capital stocks in the U.S.

Galindo and Mendez-Picazo (2013) conducted research on the innovation sector to investigate the relationship between innovation and economic growth, using generalized least square (GLS) cross-section weights and panel least squares methodologies. Their analysis indicated that the factors influencing GDP were: innovation which is measured by the proxy; patents, measured in number of patents issued; private investment; and human capital, all measured in millions of USD.

An and Yong (2010) applied the Cobb-Douglass production function in the health service sector to examine the efficiency of Chinese medical health services in various locations in China. Factors considered as affecting the health service output were determined by the total number of outpatients, inpatients and services. The factors identified are the medical health service synthesis technology efficiency (A), the number of medical staff (L) and capital investment to medical health service proxied by institution fixed assets (K). The findings show that increasing labour and investment input once, will increase output once.

2.9 Other methods used by empirical studies of the ICT, economic growth and SME relationships

Since the 1990s, ICT usage and the number of SMEs have grown and are important factors affecting economic growth. Numerous studies have been conducted to analyse the relationship between ICT and economic growth and ICT and SME productivity. Most studies have applied the commonly used production function theory, whilst other studies have used alternate methods such as the logistic diffusion model path analysis and structural equation modelling (SEM).

Lee et al. (2011) used the logistic diffusion model, as their objective was to examine the nonlinear relationship of factors affecting fixed and mobile broadband diffusion in 30 OECD countries. Lee et al. identified factors affecting fixed broadband diffusion included local loop unbundling (LLU), income, population density, education, and fixed broadband price. The initial mobile broadband services diffusion was determined by population density and standardization policies. The study also found that mobile broadband services complemented the fixed broadband services in the initial deployment of broadband in many OECD countries.

Path Analysis was used by Bayo-Moriones et al., (2013) to test the relationship between the direct and indirect effects of ICT resources on SME performance, using data from 267 Spanish manufacturing SMEs. The results confirmed that the impact of ICT on performance takes place indirectly through the improved internal and external communications, as well as through operational performance. To investigate the structural form explaining SME productivity in terms of productivity sources such as ICT, innovation and firm productivity, Díaz-Chao et al. (2015) used the SEM tool to analyse the relationships between and among the explanatory factors for productivity.

In ASEAN, the more developed countries will not necessarily derive greater benefits than less developed countries from both in-house and outsourced ICT development. Indonesia, which has the lowest per capita income, has a relatively higher value-added factor compared with Singapore, Malaysia and Thailand. The Indonesian ICT manufacturing sector had the highest output multiplier compared with the other three countries. Singapore had the lowest output multiplier compared with the other nations. However, the size of the ICT manufacturing sector as a percentage of GDP in Singapore is relatively higher than those of Malaysia, Thailand and Indonesia. This study also found that the impact of ICT on the economy will depend on the structure and the intensity of the ICT sector in the economy. Transportation, communication and services sectors used ICT services products more intensively than other sectors, followed by manufacturing. trade, and hospitality, except for Malaysia (Irawan, 2014). This study used a comparative analysis based on an input–output (I-O) table for four ASEAN member states: Indonesia, Singapore, Malaysia and Thailand.

2.10 The Technology Adoption Framework

Frameworks used to assess technology adoption have been developed based on the individual or business view. The following frameworks focus on individuals: Technology Acceptance Model-TAM (Davies, 1989), Cellular Telephone Adoption Model (Kwon and Cindabaram, 2000), The Unified Theory of Acceptance and Use of Technology (Vekantesh et al., 2003), Consumer-specific Technology Acceptance Model (Bruner and Kumar, 2005), and Theory of Reasoned Action (Fishbein and Ajzen, 2011). On the other hand, frameworks based on the business perspective include: Diffusion of Innovation Theory (DOI) (Roger, 1995; Fichman 2000), and Technology, Organisation, and Environment (TOE) (Tornatzky and Fleischer, 1990).

TAM considers individual culture value orientation, customer perceived value and demographic factors (Davis (1989). It is based on five variables: (1) perceived usefulness (PU); (2) perceived ease of use (PEU); (3) attitude toward use; (4) intention to use; and (5) actual use. TAM is the most prominent individual technology adoption framework. The main strength of TAM is its parsimony: intentions to use a technology influence usage behaviour, PU and PEU determine intentions to use. PU is the degree to which a person believes that using a particular system will help to improve his or her job performance. PEU is the degree to which a person believes that using a particular system would be effortless. TAM has the power to predict an individual's intention to adopt new technology.

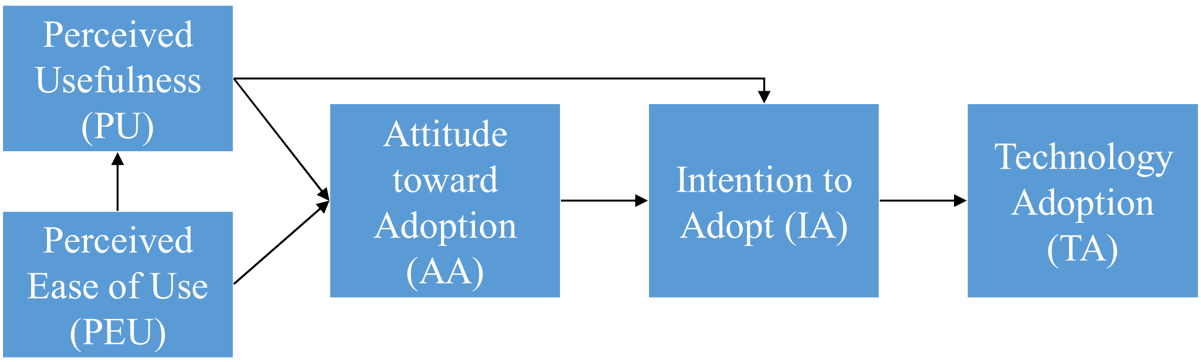


Figure 2-4 The TAM Framework

Source: Davis, 1989

The cellular telephone adoption model suggests that user acceptance of new technology is affected directly and/or indirectly by five factors: (1) individual characteristics, (2) perceived ease of use, (3) perceived usefulness, (4) enjoyment or fun, and (5) social pressure (Kwon and Cindabaram, 2000; Rudito, 2010). The Unified Theory of Acceptance and Use of Technology determined that the intention to adopt technologies is predicted by four factors: performance expectation, effort expectancy, social influence and facilitating conditions. The moderators for behaviour intentions are gender, age, experience and ease of use, and the users' intention to use technologies (Venkatesh et al., 2003; Rudito, 2010). The Consumer-specific Technology Acceptance Model (C-TAM) extends the TAM model by incorporating both utilitarian (perceived usefulness) and hedonic aspects (fun/pleasure) of technology use. It also considers the effect of external variables such as: (1) Internet devices; and (2) consumer visual orientation (Bruner and Kumar, 2005).

The DOI assesses technology adoption in the context of an organisational innovation that is disseminated through certain channels over time and within a firm (Roger, 1995). DOI examines the diffusion of innovation throughout an organisation from three perspectives: (1) individual characteristics which indicate the leaders' attitude toward change, (2) internal characteristics of organizational structure, and (3) the external characteristics of an organisation (Roger, 1995; Oliviera and Martins, 2011). However, researchers identified several drawbacks with the DOI (Fichman, 1992; Ta et al, 2009; Erisman, 2013). First, some of its variables do not match the organizational context. Second, organization adoption is not a binary event, and therefore it is only one stage in a process than evolves over time. Third, it involves interactions between stakeholders.

The TOE framework assesses business technology adoption utilising three context: technological, organizational, and environmental (Tornatzky and Fleischer 1990, Oliviera and Martins, 2011). The technological context describes both the internal and external technologies relevant to the firm. Next, the organizational context refers to the descriptive measures of an organization such as its scope, size, and managerial structure. The environmental context is the arena in which a firm conducts its business, its industry, competitors, and dealings with the government.

The TOE framework as originally presented, and later applied in IT adoption studies, provides a useful analytical framework that can be used for studying the adoption and assimilation of different types of IT innovation. TOE expands DOI theory by including consideration of the environment. The environment context presents both constraints and opportunities regarding technological innovation. The TOE framework makes Rogers' innovation diffusion theory better able to explain intra-business innovation diffusion (Oliviera and Martins, 2011).

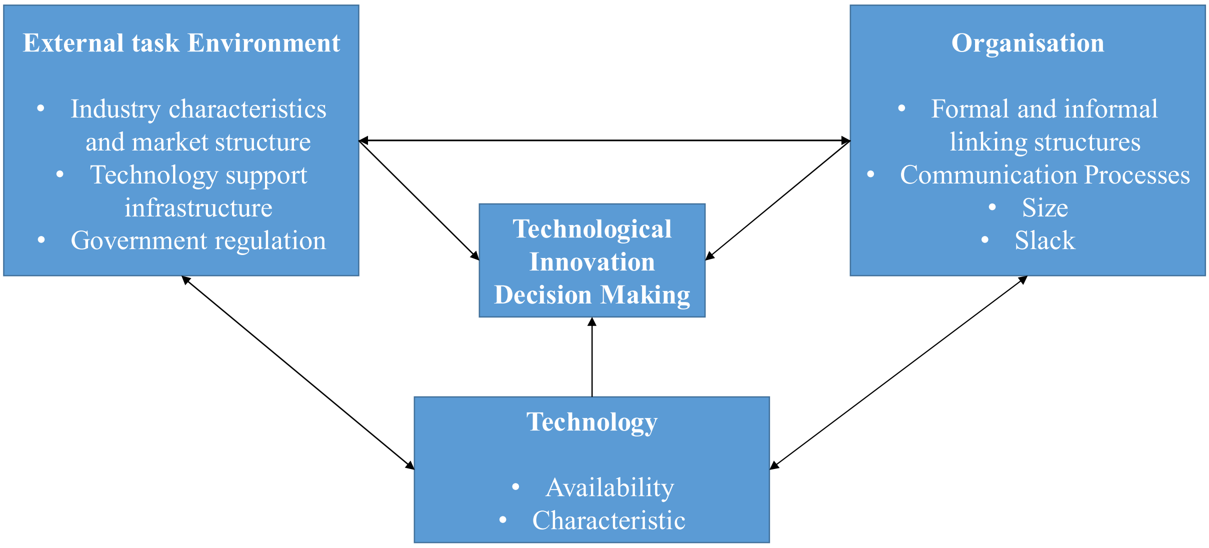


Figure 2-5 The TOE Framework

Source: Tornatzky and Fleischer, 1990

2.11 Summary

Capital investment, technology and labour are the main sources of economic growth according to modern economic growth theory that is based on the production function model. The Cobb-Douglass production function is the most common model used in the literature to investigate not only the impact of ICT on economic growth, but also on other areas such as agriculture, energy, organisational efficiency and health services. Most of the studies on the influence of

ICT on economic growth consider the ICT capital as investment in ICT such as computers and software.

In recent years, the ICT service delivery model has evolved from being an in-house or self-managed service to an outsourced model, that enables SMEs to utilise the most recent ICT technology at a lower cost and without the need for related human resource skills. This shift indicates that ICT services should play a more significant role in developing SME productivity, even though the current rate of adoption is still very low. To maximise this potential opportunity, it is important to investigate the impact of ICT services in SME productivity.

The research presented in this thesis considered the SME ICT services as an independent variable in the Cobb-Douglass production function, in order to investigate its influence on economic growth. In addition, this research investigated the adoption of ICT services by SMEs, applying the adoption framework.

Chapter 3 explains the secondary data analysis and the methodology applied.

Chapter 3 Secondary Data: Method and Dataset

3.1 Introduction

This chapter explains panel regression analysis, which was used to examine the secondary data. The research methods of interest are panel based unit root tests and fixed effect regression analysis. The secondary data analyses presented here aim to address Q1 and Q2, which focus on the influence of ICT services on economic growth with and without other economic growth variables. In addition, this analysis will answer part of Q3, the impact of ICT services, utilised by SMEs, on the Indonesian economy.

The reminder of the chapter is organised as follows. Section 3.2 describes the secondary data method applied in this research. Section 3.3 explains the econometric technique of panel regression. Section 3.4 discusses the secondary data used.

3.2 Secondary Data Method

Secondary data is a set of numeric (quantitative) or non-numeric (qualitative) data that have already been gathered or compiled in some way. Secondary data analysis is an empirical method based on data collected by a third party or by other people (Church, 2001). This study made the assumption that existing relevant data can be used where the data is applicable to the focus of the research. Data collection funded by government or private institutions often involves large samples that are more representative of a target population and hence have higher validity (Smith, 2008). Gaining access to secondary data is suitable for unobtrusive research, with a limited budget for data collection, where there is a need to cover a wide geographic area and over a substantial period of time.

However, some limitations must be considered when using this method, including: (1) original and detailed data are often not published in reports due to space limitations (Church, 2001); (2) the data may be collected for other purposes and therefore may not be appropriate for a different research design (Smith, 2008); and (3) the data gathering design and mechanisms may not be explained in the report (Church, 2001). To overcome such limitations, a researcher must evaluate data validity and reliability, and verify data accuracy.

To study the global association trend between ICT Services and a national economy, and the relationship of ICT services to other related factors, this research used secondary data. It was anticipated that the findings would answer Q1 and Q2. After investigating the global trends, the analysis focuses on the Indonesian context. Secondary data is also used to examine the influence of ICT services and SMEs on Indonesia's economy, to address part of Q3.

The secondary data collected for this study was divided into two parts. The first part of the secondary data was used to conduct cross-country analysis. It examined the role of global ICT services in 28 developed and 15 developing countries from 1970 to 2013. Another aim of this study was to discover the association between ICT services and other growth factors. Additionally, a similar analysis was conducted for the Indonesian context using part of the data to investigate the role of Indonesian SMEs in the national economy from 2003 to 2013. For this purpose, this research gathered secondary data from four international database publications: (1) the World Bank database (World Bank Database, 2015); (2) the IMF annual database (IMF, 2015); (3) ILO database (ILO, 2015); and (4) the ITU database (ITU, 2014). Figure 3-1 shows the secondary data sources used for this research.

The World Bank Database provided actual GDP figures. Gross fixed capital (GFC) and changes in inventory (CI) to calculate the total capital were obtained from the IMF annual database. The labour capital variable was obtained by multiplying the total labour numbers from the ILO database by the total labour hours sourced from the ILO database and IMF annual database. The ITU database provided the following data: the ICT services capital ICT services components (including fixed telephones and mobile telephones); and investment in ICT infrastructure capital.

The second part of the secondary data was used to study the Indonesian context. This investigates the Indonesian SME role in the national economy over the period 2003 to 2013.

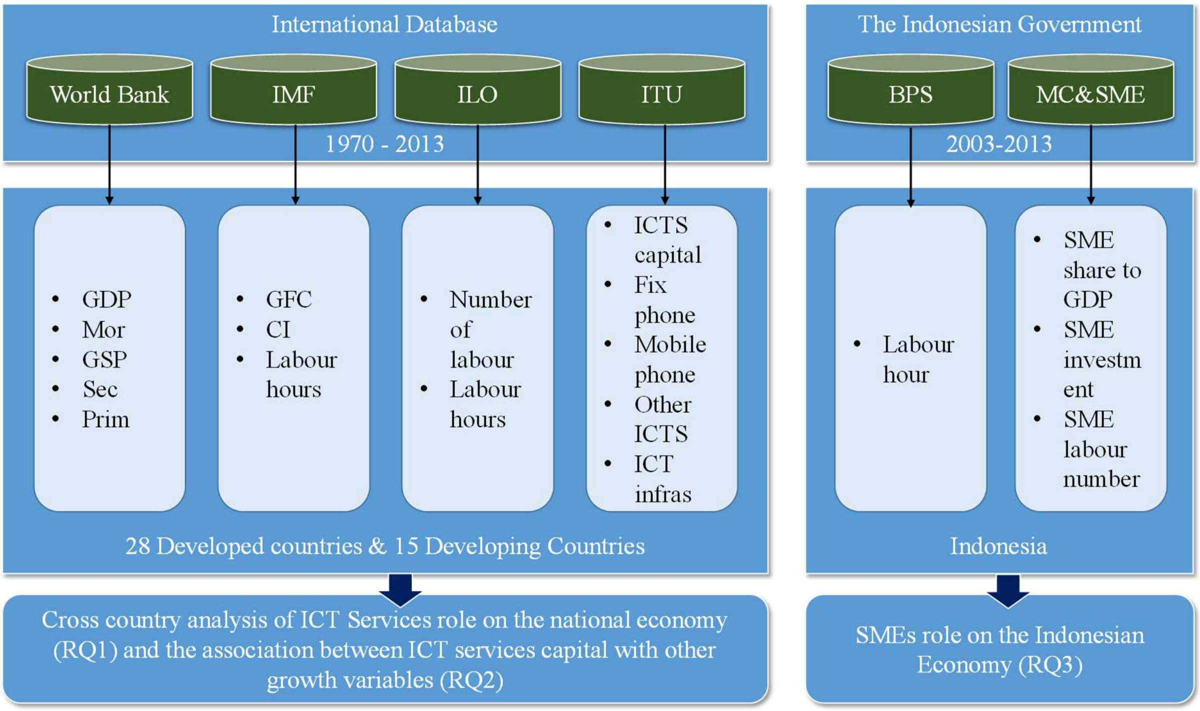


Figure 3-1 Secondary Data Collection

The secondary data for this study was obtained from two Indonesian Government data sources. The first source is the MCSME database. SME share to GDP represents the output variable (Y) and investments by SMEs represent the SME total capital (K). The number of SME employees was also sourced from this database. The second database, the Central Statistical Bureau of Indonesia (Biro Pusat Statistik /BPS), provided average Indonesian weekly labour hour data. The employee numbers and labour hour rates were used to construct the labour capital (L) variable. Details of the secondary data sources are presented in Figure 3-1.

3.3 Panel Regression Analysis

3.3.1 Panel Unit Root Test

To determine whether the data is of order ($I(0)$) or ($I(1)$), a panel unit root test was conducted on all variables before conducting a panel regression. The five types of panel unit root test applied in this analysis were: (1) Levin, Lin & Chi (LLC), (2) Breitung, (3) Im, Pesaran and

Shin (IPS), (4) Augmented Dickey-Fuller Fisher Chi-square (ADF Fisher) and (5) Philips-Peron Fisher (PP Fisher). The generic panel model for the unit root test is as follows:

$$y_{it} = \rho_i \, y_{i,t-1} + X'_{it}\delta_i + u_{it} \tag{3-1}$$

Where y_{it} is the dependent variable, X_{it} is the independent variable, i is the individual $i = 1, \ldots .N$ and t is time series $t = 1, \ldots, T$, ρ is the autoregressive coefficient, δ is the parmeter of the model, and u_{it} is the error term. The generic unit root test considers the following conditions:

(1) If $|\rho_i|$ <1, then y_i is stationary;

(2) If $|\rho_i|$ = 0, the y_i is non-stationary.

The LLC test involves pooling cross-section time series data for testing the unit root hypothesis. The degree of persistence in the individual regression error, the intercept, and trend coefficients are allowed to vary freely across individuals (Levin et al, 2001). LLC assumes that all individuals in the panel have identical first-order partial autocorrelation, but all other parameters in the error process are permitted to vary freely across individuals. The data panel with output (y_{it}), where i is the individual $i = 1, \ldots .N$ and t is time series $t = 1, \ldots, T$, assumed:

1. y_{it} is generated by either any one of these three equations:

$$\Delta y_{it} = \delta y_{it} + u_{it} \tag{3-2}$$

$$\Delta y_{it} = \alpha_{0i} + \delta y_{it} + u_{it} \tag{3-3}$$

$$\Delta y_{it} = \alpha_{0i} + \alpha_{1i} t + \delta y_{it} + u_{it} \text{ , where } -2 < \delta \leq 0, for\ i = 1, \ldots, N. \tag{3-4}$$

2. The error process u_{it} is distributed independently across individuals and follows a stationary invertible ARMA process for each individual.

3. For all $i = 1, \dots N$ and $t = 1, \dots . T$.

Table 3-1 explains the hypothesis test for assumption a. In equation (3-2), the unit root test assumes that y_{it} has neither individual mean nor time trend, equation (3-3) indicates that y_{it} has individual specific mean but no time trend, while in equation (3-4) y_{it} has both individual mean and time trends. This study applied equation (3-4).

Table 3-1 Hypothesis test for LLC Unit Root

Equation	**Hypothesis test**
(3-2)	H_0: $\delta = 0$ H_1: $\delta < 0$
(3-3)	H_0: $\delta = 0$ and $\alpha_{0i} = 0$, for all i, H_1: $\delta < 0$ and $\alpha_{0i} \in R$
(3-4)	H_0: $\delta = 0$ and $\alpha_{1i} = 0$, for all i, H_1: $\delta < 0$ and $\alpha_{1i} \in R$

The Breitung test uses a standard normal limiting distribution as *N* and *T* tend to infinity. The test procedure is further generalized to accommodate individual-specific intercepts or linear time trends (Breitung and Das, 2005). LLC and Breitung tests are for common unit root process (homogeneous) assuming a common AR structure for all of the series. While IPS, ADF Fisher and PP Fisher are tests with individual unit root process (heterogeneous) that allow for a heterogeneous coefficient of $y_{i,t-1}$.

The IPS test is obtained as an average of ADF statistics. It allows for heterogeneity both in intercept and slope terms for the cross-section units and solves the serial correlation problem. While the ADF Fisher test addresses lags of Δy_t as regressors in the test equation, the PP Fisher test makes a non-parametric correction to the t-test statistic. IPS suggest an average of the ADF tests when u is serially correlated with different serial correlation properties across cross-sectional units. The hypothesis for this test is:

(1) H_0: $\rho_i = 0$, for all i;

(2) H_1: $\begin{cases} \rho_i < 0; & for\ i = 1, \dots, n_1 \\ \rho_i = 0; & for\ i = n_1 + 1, \dots, n. \end{cases}$

The PP Fisher test approach is nonparametric with respect to nuisance parameters and therefore allows for a very wide class of weakly dependent and possibly heterogeneously distributed data (Philips and Perron, 1998). This test combines the p-values from unit root tests for each cross-section to test for unit root in the panel data.

The null hypotheses for all of the tests in this study are that it has a unit root or is stationary. In this study, it was assumed that the panel data have individual means and time trends. Then the unit root test result of each variable was determined by the majority result of the five tests.

3.3.2 Panel Estimation

Panel estimation is commonly in the literature as it provides flexibility when modelling the differences in behaviour across individuals. It employs panel data that combines a time series of cross-section data. Hence, it increases the power of estimation for a large amount of data, in terms of more information provided, more variability, less collinearity among variables, more degrees of freedom, and more efficiency. It can take heterogeneity explicitly into account, minimise the bias, and analyse more complex models. Furthermore, it has the ability to detect the dynamics of change, such as the impact of technology (Gujarati, 2003). Therefore, several studies applied the panel estimation method to examine the influence of ICT as the representative of technology (Djiofack-Zebaze and Keck, 2008; Vu, K.M., 2011; Lee et al., 2012, Ahmed and Ridzuan, 2013, Ilmakunnas and Miyakoshi, 2013; Turen, 2016). However, there are several drawbacks with panel estimation. The problems relate to the cross-sectional data, such as heteroscedasticity, and time series data problems such as autocorrelation. Another problem is cross-correlation in individual units at the same point of time (Gujarati, 2013).

The basic panel regression model is:

$$Y_{it} = \beta_1 + \beta_2 X_{2it} + \beta_3 X_{3it} + \varepsilon_{it} \tag{3-5}$$

where i represents the ith cross-sectional unit at tth time period. This study used balanced panel data, where each of the cross-section units has the same number of time series observations (Gujarati, 2003).

3.3.3 Global ICT Services Role: A Cross Country Analysis

In this research, several panel estimation models incorporating Cobb Douglas Production Function were estimated with ICT services capital representing a part of (A) (Solow, 1957; Jorgenson and Stiroh, 1999; Ilmakunnas and Miyakoshi, 2013; Jalava and Pohjola, 2007; Samoilenko and Osei-Bryson, 2008; Cecobeli, 2012). To begin with, a Solow type model that is augmented with ICT services was developed[6]:

$$Y_{it} = \beta_1 K_{it} + \beta_2 KICTS_{it} + \beta_3 L_{it} + \varepsilon_{it} \tag{3-6}$$

Here ε_{it} accounts for the part of Y_{it} unexplained by the model.

[6] *(Jorgenson and Stiroh, 1999), (Ketteni et al, 2011), (Ilmakunnas and Miyakoshi, 2013), (Jalava and Pohjola, 2007), (Galindo and Picazo, 2013), (Ahmed and Ridzuan, 2013), (Quatraro, 2011), (Dedrick et al. 2013), Thompson Jr. and Garbacz, 2007), (Matambalaya and Wolf, 2001), (Samoilenko and Osei-Bryson, 2008)*

Next, to investigate the interaction of ICT services with other growth variables, ICT services is capital-augmenting ($K_{it}KICTS_{it}$) and labour-augmenting ($L_{it}KICTS_{it}$). Then the panel estimation model becomes:

$$Y_{it} = \beta_1 K_{it}KICTS_{it} + \beta_2 L_{it}KICTS_{it} + \varepsilon_{it} \tag{3-7}$$

Then (3-6) was combined with (3-7) to estimate the whole model[7]:

$$Y_{it} = \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 K_{it}KICTS_{it} + \beta_4 L_{it}KICTS_{it} + \varepsilon_{it} \tag{3-8}$$

To examine the role of ICT services on the country economy, a related ICT services variable, ICT service infrastructure (KINF) is also considered in the model. Therefore, the model for this analysis is as follow[8]

$$\begin{aligned} Y_{it} = \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 KINF_{it} + \beta_4 K_{it}KICTS_{it} + \beta_5 L_{it}KICTS_{it} \\ + \beta_6 KINF_{it}KICTSi_{it} + \varepsilon_{it} \end{aligned} \tag{3-9}$$

The models account for the fact that not all labour or capital components are augmented with ICT services. The new growth model examines the impact of technology related capital to the economic growth by encapsulating technology (A) with physical and human capital ($k_t = K_t/L_t$), ($y_t = Y_t/L_t$), and ICT services represents the technology (A). Therefore, this study developed a per population model based on the new growth model approach, as follows:

$$\begin{aligned} y_{it} = \beta_1 k_{it} + \beta_2 kinf_{it} + \beta_3 kicts_{it} + \beta_4 k_{it}kicts_{it} + \beta_5 kinf_{it}kicts_{it} \\ + \varepsilon_{it} \end{aligned} \tag{3-10}$$

---

[7] *(Samoilenko and Ossei-Bryson, 2008)*

[8] *(Vu, K.M., 2011), (Samoilenko and Osei-Bryson, 2008); (Lee et al, 2011); (Gibbs and Tanner, 1997); (Bayo-Moriones et al., 2011); (Jorgenson and Stiroh., 1999, 2003); (Basu and Fernald, 2007); (Ahmed and Ridzuan, 2013); (Dedrick et al., 2013); (Turen et al., 2016) used investment in Telecom infrastructure to represent ICT capital also used similar model for the study*

Where y_{it} is GDP/population, k_{it} is capital per population, $kicts_{it}$ is ICT services capital per population, and $kinf_{it}$ is infrastructure capital per population. Meanwhile, i and t refer to the country i at the time t.

Finally, to study the impact of the previous (0 to 4) annual capital spending on the current economy, a lag panel estimation model was constructed. The lag model for ICT service role in the national economy is:

$$y_{it} = \beta_1 \sum_{4}^{0} k_{it} + \beta_2 \sum_{4}^{0} kinf_{it} + \beta_3 \sum_{4}^{0} kicts_{it} + \beta_4 \sum_{4}^{0} k_{it} kicts_{it} + \beta_5 \sum_{4}^{0} kinf_{it} kicts_{it} + \beta_6 \sum_{4}^{1} y_{it} + \varepsilon_{it} \quad (3\text{-}11)$$

3.3.4 ICT Services influence on the Indonesian Economy

The data applied in this analysis is time series data for Indonesia, as part of the panel dataset from the developing countries panel. The unit root test is conducted based on the ADF test. This test is run by "augmenting" the three preceding equations by adding the lag values of the dependent variable ΔY_t:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-1} + \varepsilon_t \quad (3\text{-}12)$$

Where $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc (Gujarati, 2003).

Recall equations (3-6) to (3-9) for the estimation model. Hence, the estimation models for this analysis are as follow:

$$Y_t = \beta_1 K_t + \beta_2 L_t + \beta_3 KINF_t + \beta_4 KICTS_t + \varepsilon_t \quad (3\text{-}13)$$

$$Y_t = \beta_1 K_t KICTS_t + \beta_2 L_t KICTS_t + \beta_3 KINF_t KICTS_t + \varepsilon_t \quad (3\text{-}14)$$

$$Y_t = \beta_1 K_t + \ \beta_2 L_t + \beta_3 KINF_t \qquad (3\text{-}15)$$
$$+ \beta_4 KICTS_t + \beta_5 K_t KICTS_t + \ \beta_6 L_t KICTS_t$$
$$+ \beta_7 KINF_t KICTS_t + \varepsilon_t$$

Meanwhile, the estimation model for the per population and lag model are as follows:

$$y_t = \beta_1 k_t + \beta_2 kinf_t + \beta_3 kicts_t + \ \beta_4 k_t kicts_t + \beta_5 kinf_t kicts_t + \varepsilon_t \qquad (3\text{-}16)$$

$$y_t = \beta_1 \sum_4^0 k_t + \ \beta_2 \sum_4^0 kinf_t + \beta_3 \sum_4^0 kicts_t + \ \beta_4 \sum_4^0 k_t kicts_t \qquad (3\text{-}17)$$
$$+ \beta_5 \sum_4^0 kinf_t kicts_t + \beta_6 \sum_4^1 y_t + \varepsilon_t$$

3.3.5 SME Role in the Indonesian Economy

The study of the role of Indonesian SMEs on the national economy also applied the panel regression technique. Recalling (3-6), with the variable adjustments for this study, the model becomes:

$$Y_{it} = \beta_1 K_{it} + \beta_2 L_{it} + \varepsilon_{it} \qquad (3\text{-}18)$$

Where Y_{it} is SME contribution to GDP, K_{it} is SME total investment and L_{it} is labour capital that is represented with total hours worked.

This analysis also examines the interaction effect between total capital and labour capital. The model becomes:

$$Y_{it} = \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 K_{it} L_{it} + \varepsilon_{it} \qquad (3\text{-}19)$$

Next, to investigate the lag effect of SMEs on the Indonesian economy, the following models are applied:

$$Y_{it} = \beta_1 \sum_{4}^{0} K_{it} + \beta_2 \sum_{4}^{0} L_{it} + \beta_3 \sum_{4}^{1} Y_{it} + \varepsilon_{it} \tag{3-20}$$

$$Y_{it} = \beta_1 \sum_{4}^{0} K_{it} + \beta_2 \sum_{4}^{0} L_{it}\ \beta_2 + \sum_{4}^{0} K_{it} L_{it} + \beta_4 \sum_{4}^{1} Y_{it} + \varepsilon_{it} \tag{3-21}$$

3.4 The Secondary Data

A balanced panel dataset from the secondary data sources, as explained in Section 3.2, was gathered to study the global trend of the ICT services role in national economies. In addition, another set of the secondary data was used to investigate the SME role in the Indonesian economy.

3.4.1 The Cross-Country Data

The secondary data gathered for this study covers 28 developed countries and 15 developing countries, over the period 1970-2013. The countries were grouped based on the World Bank 2015 country classifications (World Bank, 2015). The secondary data collected includes the real GDP, total capital, labour capital, ICT service capital, ICT infrastructure capital, mortality rate and education factors.

The real GDP (Y) as a dependent variable was sourced from the World Bank database (World Bank Database, 2015). Total capital (K) was calculated as gross fixed capital plus changes in inventory and was sourced from the IMF annual database (IMF, 2015). The labour (L) variable represents the annual labour hours worked, where the total number of labour hours was found using the ILO database (ILO, 2015). The labour hourly rate was sourced from the ILO database and IMF annual database. The labour hours were chosen to represent the labour, because this value has a narrower spread among countries, compared to labour wages or labour cost. The ICT services capital ($KICTS$) and investment in ICT infrastructure ($KINF$) data were sourced from the ITU database (ITU, 2014). The GDP, total capital, ICT services capital and investment in ICT infrastructure were converted to US dollars. The ICT services capital comprised ICT service operator revenue from households, government and businesses. All of the variables are expressed in natural log form.

Further, this analysis also employed per capita variables denoted using lower case. GDP per population is y, total capital per population is k, ICT service capital per population is $kicts$, and ICT infrastructure capital per population is $kinf$.

Table 3-2 Variable definition and source for cross-country analysis

Variable	Definition	Source
Y	Real GDP in US$	GDP: World bank database, National currency rate conversion to US$: IMF annual database.
K	Total capital = gross fixed capital + change in inventory	IMF annual database.
L	Labour capital in total labour hours worked annually = number of employee * average labour hours worked	ILO Statistics and database, IMF annual database and Central Statistical Bureau of Indonesia (for Indonesia LH from year 2000-2013).
$KICTS$	ICT services capital: ICT services spending by persons, government and firms	ITU World Telecommunication/ICT indicators database 2014
$KINF$	ICT infrastructure capital: investment on ICT infrastructure	ITU World Telecommunication/ICT indicators database 2014

3.4.1.1 The Global ICT Services Trend

Countries with a gross national income per capita of at least US$12,736 comprised the developed country group. The developed panel consisted of 28 countries: (a) Europe - Austria, Belgium, Canada, Cyprus, Denmark, Finland, France, Germany, Greek, Iceland, Ireland, Italia, Luxemburg, Malta, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and

United Kingdom; (b) America - USA; (c) Asia - Hong Kong, Japan, South Korea and Singapore; and (d) Pacific - Australia and New Zealand.

The developing countries are those countries with a lower income per capita than that of the developed nations. The panel of developing countries consisted of 15 nations: (a) America - Columbia, Mexico, Costa Rica, Panama, Dominica Republic, Peru, and El Salvador; (b) Asia - China, Indonesia, India, Malaysia, Philippines, Sri Lanka and Thailand; and (c) Africa - Egypt.

According to the data presented in Table 3-3, fixed-line telephones in developed countries have reached the maturity stage, while in developing countries they are still growing at an average year on year (YoY) rate of 3%. Fixed-line telephones have the highest share compared to other ICT services, both in developed and developing countries. Therefore, this share is declining, both in developed and developing countries. On the other hand, the number of mobile telephones in developing countries is growing rapidly. Over the period 1970 to 2013, the average mobile telephone share to all ICT services reached 38% and is increasing by 35% per year, greater than in developed countries where it is only 27% and 16%, for the share and average YoY growth respectively. This situation is due to the lack of landline infrastructure in developing countries (James, 2011; Howard, 2009). The other services, which include Internet and cloud computing, in developing countries are still in the early or introduction stage, with only 15% share, but they are growing phenomenally at 116% per year. Meanwhile, in developed countries, they have been increasing with 27% share and 14% average YoY growth. The ITU (2016) projected that the Internet penetration in developing countries will increase to 67% in five years, from 2011 to 2016. China's Internet users have grown in number 400 fold in fourteen years, from one million users in 1997 to 400 million users in 2011 (Dedrick et al., 2011). In total, the annual average growth of ICT services capital in developing countries is almost twice that of the developed countries. Thus far, previous studies have confirmed that the appreciation of the ICT role in developing countries is growing faster than it is in developed countries (Turen et al., 2016; Ghani, 2015; Dedrick et al., 2011). This is also shown in Figure 1 and Figure 2, where the ICT services capital chart trend in developed countries is flat, in contrast to the developing countries where it shows a sharp increase.

Table 3-3 Average ICT services in Developed and Developing countries (1970-2013)

	Total $ICTS$	Fix phone	Mobile	Other*
Developed				
Average (US$)	31.56	14.85	9.85	6.80
Average YoY growth	0.06	0.00	0.16	0.23
Average share	NA	0.46	0.27	0.27
Average share YoY growth	NA	-0.04	0.11	0.14
Developing				
Average (US$)	11.10	3.83	5.91	1.50
Average YoY growth	0.11	0.03	0.35	1.16
Average share		0.47	0.38	0.15
Average share YoY growth		-0.07	0.21	1.24

* Other includes Internet, cloud computing, manage services, and data communication. *Source: ITU*

3.4.1.2 The Other Capital

In terms of total capital, the mean of change in inventory and the gross capital in developed countries is almost equal to GDP (99.08%), while in developing countries, the mean of total capital per GDP is only 0.53%. However, the charts in Figure 3-2 and Figure 3-3 show that the total capital trend in developing countries has increased more sharply than in the developed nations.

The mean of the labour hours worked in developing countries is 63.73 times that of developed countries. This profile is generated by considering the number of employees. Most developing countries employ more people in industry, especially in China, India and Indonesia. However, the average annual working hours in developed and developing countries is similar.

Table 3-4 Common Statistics on the variables

	Y ($US bill)	K (US$ bill)	L (hours)	$KICTS$ ($US bill)	$KINF$ ($US bill)
Developed					
Mean	1,092	1,082	12,788,999	30	14
Median	307	75	26,563	8	3
Max.	16,245	32,980	403,082,742	561	311
Min.	4	-	273	-	-
Std. Dev.	2,349	4,325	49,354,923	73	38
Obs.	456	456	456	456	456
Developing					
Mean	380	2	815,004,131	12	4
Median	75	0	53,586,614	3	1
Max.	8,256	53	11,940,399,057	171	32
Min.	10	-	-	0	0
Std. Dev.	1,126	7	2,546,000,305	26	7
Obs.	182	182	182	182	182

The developed countries have invested in ICT infrastructure more so than the developing countries. The mean of ICT infrastructure capital in developed countries is 3.5 times that of the developing countries. However, the charts in Figure 3-2 and Figure 3-3 reveal that the ICT infrastructure capital in developing countries is increasing significantly, while in developed countries it is flatter. The ASEAN countries, most of which are developing countries, are improving their ICT infrastructure development to catch up with the development of ICT products (Irawan, 2014).

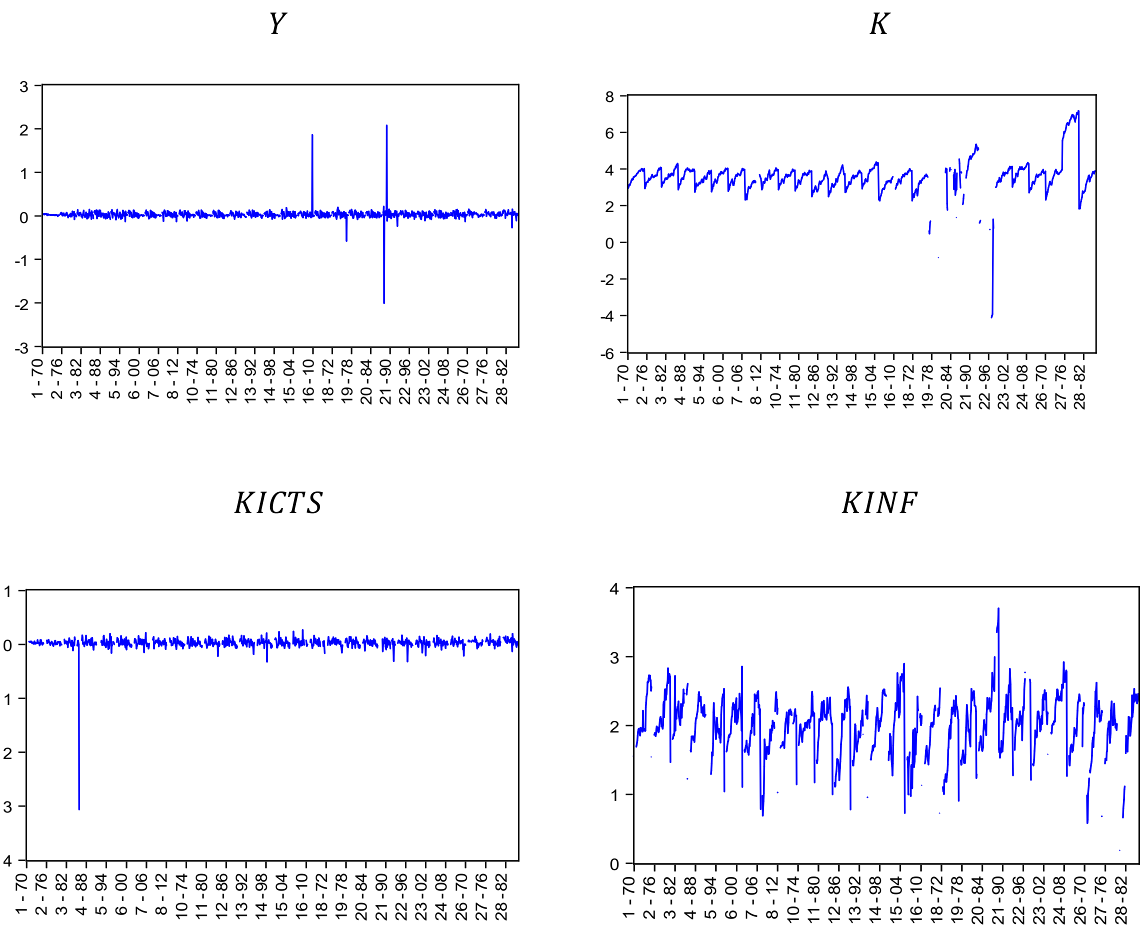


Figure 3-2 Developed Countries Data graphic

Note: Country index: (1) USA, (2) Canada, (3) Australia, (4) Japan, (5) New Zealand, (7) Belgium, (8) Cyprus, (9) Finland, (10) France, (11) Germany, (12) Greece , (13) Ireland, (14) Italy, (15) Luxemburg, (16) Malta, (17) Netherland, (18) Portuguese (19) Spain, (20) Denmark, (21) Iceland, (22) Norway, (23) Sweden, (24) Switzerland, (25) United Kingdom, (26) Hong Kong, (27) Singapore, (28) Korea (Rep)

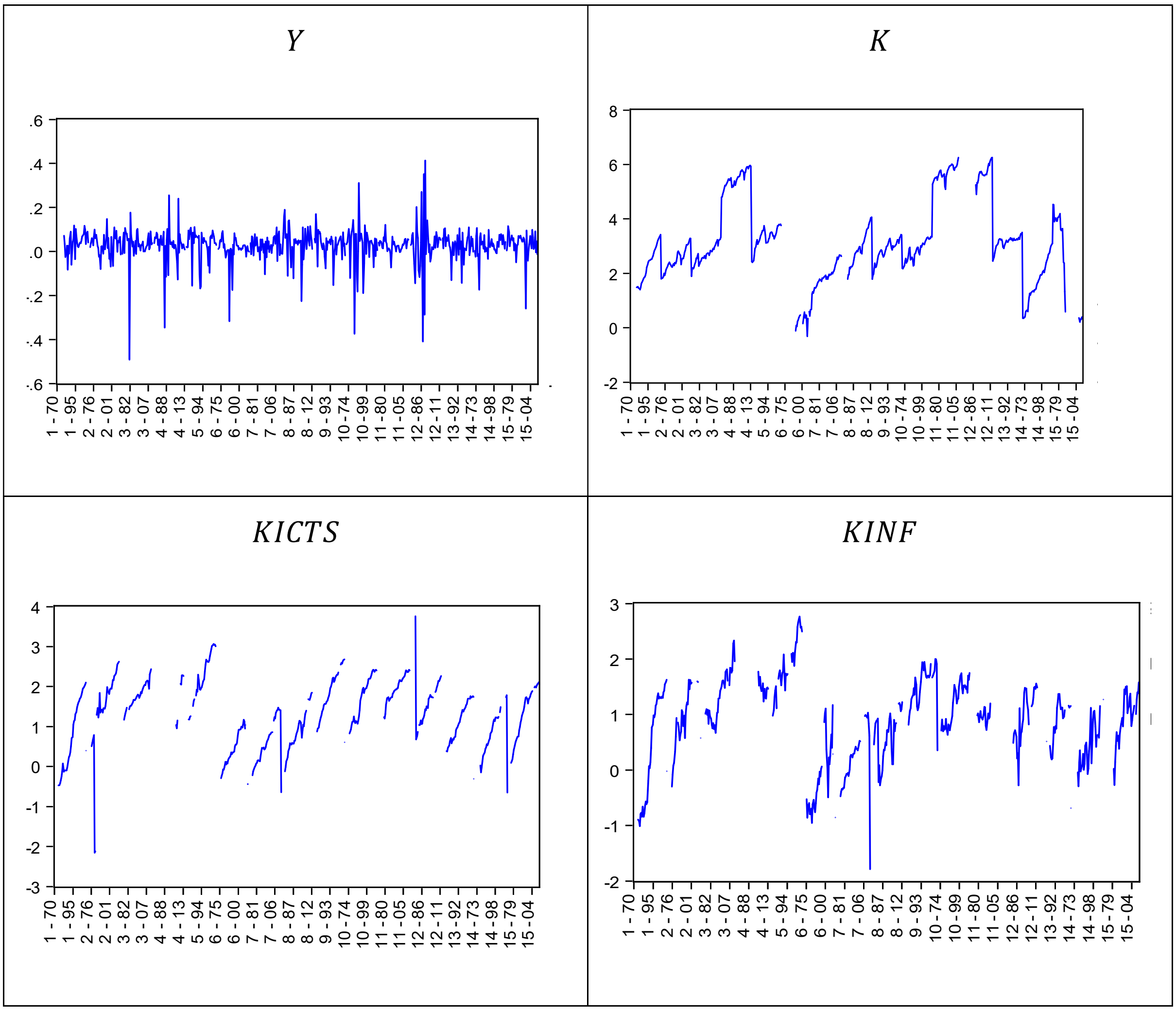


Figure 3-3 Developing Countries Data

Note: Country index: (1) China, (2) Columbia, (3) Costa Rica, (4) Dominic Rep., (5) El Savador, (6) Egypt, (7) Indonesia, (8) India, (9) Malaysia, (10) Mexico, (11) Panama, (12) Peru, (13) Philippine, (14) Sri Lanka, (15) Thailand

3.4.2 The Indonesian ICT Services

The secondary data used in this analysis is part of the cross-country panel dataset in Section 3.4.1, but only the Indonesian specific data. Table 3-5 presents the descriptive statistics of Indonesian ICT services capital, for the period 1970-2013.

The average of Indonesia ICT services capital is 21.6% of the ICT services capital for the developing nations. Nonetheless, its growth is 2% higher than the average YoY growth of the developing nations studied in this research. In terms of the contribution, fixed-line telephone contributes 73% on average, followed by other services, and mobile telephone contributes the least. This figure is slightly different from the global trend, where the mobile telephone is the second largest contributor and other services contribute the least. Other services also have an impressive average YoY growth in Indonesia, accounting for 93%. This figure confirms that Indonesia is ready to implement Cloud Computing (ACCA, 2016). Meanwhile. Indonesia's fixed-line and mobile telephone growth profiles are similar to the global trend.

Table 3-5 Indonesia ICT services capital (1970 – 2013)

	$KICTS$	Fixed phone	Mobile	Other*
Average (US$)	2.84	0.63	1.17	0.51
Average YoY growth	13%	10%	23%	112%
Average share	NA	73%	15%	22%
Average share YoY growth	NA	-6%	13%	93%

** Other includes Internet, cloud computing, manage services, and data communication. Source: ITU,2015*

In Indonesia, the mean of the total capital is higher than the mean of GDP. In terms of labour capital, on average, Indonesia employed only 0.4% of the developing countries yearly average. On average, Indonesia spent 23.7% of the developing nations average in ICT service capital, and 25.3% of the capital for ICT infrastructure.

Table 3-6 Indonesia ICT services role - variables common statistic

	GDP ($US bill)	K (US$ bill)	L (hours)	$KICTS$ ($US bill)	$KINF$ ($US bill)
Mean	184.97	418.54	3,168,291.6	2.84	1.01
Median	115.01	113.20	0	0.79	0.55
Maximum	852.31	2895.61	111,000,000	17.52	4.13
Minimum	0.00	0.00	0	0.00	0.00
Std. Dev.	209.62	726.72	47,125,477	4.59	1.16
Observations	44	44	44	44	44

3.4.3 The Indonesian SMEs

The secondary data gathered to analyse the Indonesian SME role in the national economy comprise the SME contribution to GDP (Y), investments by SMEs (K), the average Indonesian weekly labour hours. This data was sourced from the BPS. The number of SME employees was obtained from the database of the MCSME. The data is in annual figures, panel of micro, small and medium enterprises for the period of 2003 to 2013. This study does not cover the most recent periode (2014 to 2016) because of the following reasons. First, the consistent time series data are only available from 2003 to 2013. However, the data observed are sufficient statistically. Second, there is no significant shocked on Indonesia's GDP from 2014 to 2016. Therefore, this study assumed that similar situation also happened on the Indonesian SMEs from 2014 to 2016. However, further studies are strongly recommended to cover these periods when the data is available. Table 3-7 explains the variables used in the analysis.

Table 3-7 Variable definition and source for SMEs role on Indonesia's Economy

Variable	Definition	Source
Y	SMEs contribution to Indonesia's GDP (in billion IDR, annually)	The MCSME of Indonesia
K	Total capital: SMEs investment (in billion IDR, annually)	The MCSME of Indonesia
L	Labour capital: number of employee * average labour hours worked (in million hours worked, annually)	The MCSME of Indonesia and the Central Statistical Bureau of Indonesia

Table 3-8 Indonesia's SMEs - Common Statistic Report

	Y (billion IDR)	K (billion IDR)	L (thousand hours)
Mean	963,241	317,221	31,400
Median	704,088	211,979	4,460
Maximum	3,326,565	1,292,586	105,000
Minimum	199,280	38,284	2,690
Std. Dev.	773,672	268,291	39,600

Table 3-8 shows the descriptive statistics of the variables used to study the role of SMEs in Indonesia's economy. In 2013, 57.89 million SMEs accounted for 60% of Indonesia's GDP and provided 97% of Indonesia's employment. Micro enterprises are the biggest contributor (61%), followed by medium enterprises (23%) and then small enterprises (16%). The output of micro enterprises also had the highest average year on year (YoY) growth (19%). However, the output of SMEs also increased significantly at 17% and 14% respectively. In total, the SME output grew at a rate of 17% annually, from 2003 to 2013. Figure 3-4 depicts the SME output trend.

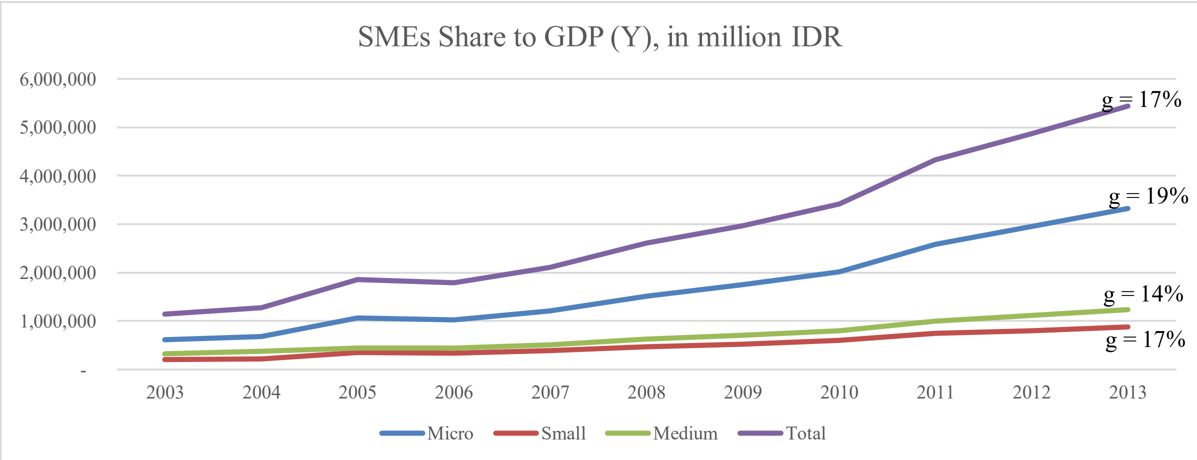


Figure 3-4 Indonesia SMEs share to GDP

Note: g is the average of year on year (yoy) growth. Source: BPS, 2003-2013

Micro enterprises had the smallest investment annually and accounted for 83% of SME capital in 2013. Medium sized businesses that comprised 0.1% of the total SMEs, contributed 51% of the SME total capital. Therefore, investment per micro business was only 0.02% of the investment for the medium-sized business. There was a dramatic increase in SME total capital in 2004, but then it decreased dramatically in 2005. The chart in Figure 3-5 shows the trend for 2005 to 2013.

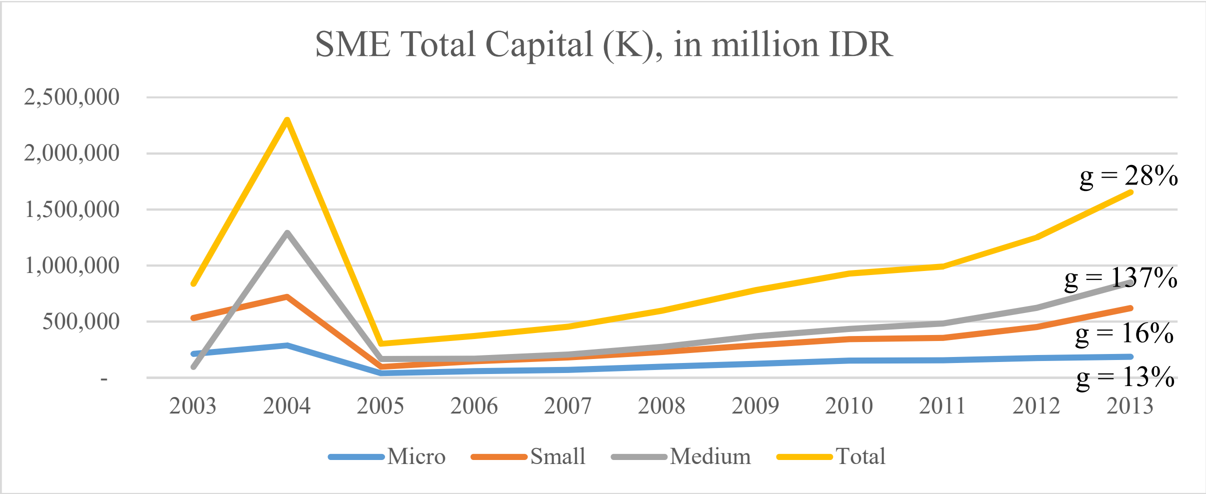


Figure 3-5 SMEs Total Capital (K)

Source: BPS, 2003-2013.

Micro enterprises contributed 92% of the total SME labour capital in 2013, while for small and medium businesses it was only 5% and 3% respectively. Therefore, the total SME labour hours trend was very close to the micro enterprises trend. Micro enterprises labour capital also grew faster than that of the other SMEs. The labour capital average YoY growth for micro SMEs was 5%, compared to 0.01% and 2% for small and medium-sized SMEs respectively. Figure 3-6 depicts the Indonesian SME labour capital trend, from 2003 to 2013.

In contrast to the labour capital figure, the output per employee shows that medium enterprises had the biggest portion and growth. The gap between the one for medium enterprises and the one for micro and small enterprises is quite significant. Medium-sized enterprise output per employee was 10 times greater than and double that of micro and small enterprises respectively.

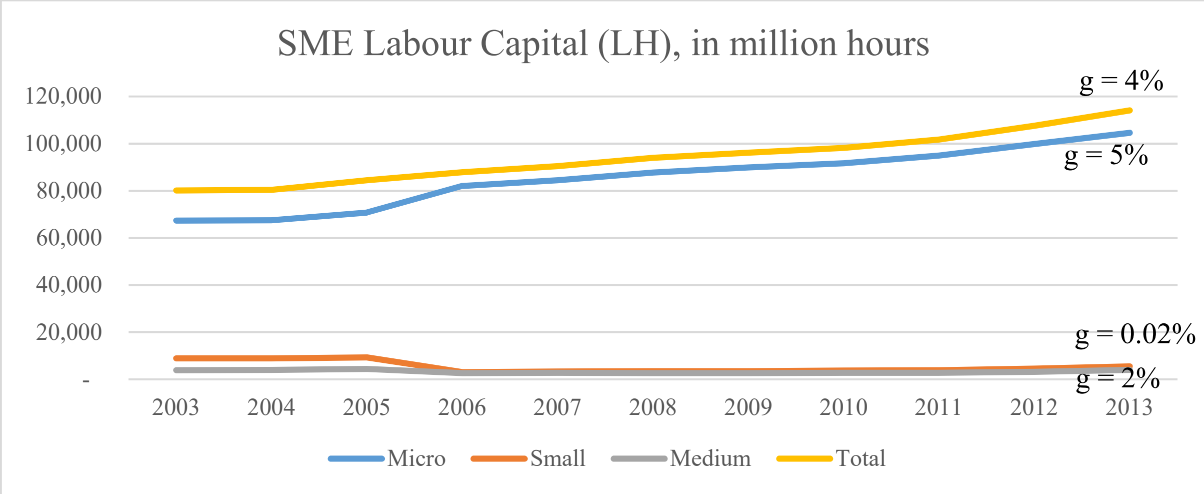


Figure 3-6 SME Labour Capital

Source: BPS, 2003-2013

3.5 Summary

This chapter presents the secondary data analysis methods. The analysis methods were applied to examine the global ICT services role on the national economy, through a cross country analysis on developed and developing countries. The findings answer Q1 and Q2. In addition, this analysis was also used to investigate the ICT services and SME role in the Indonesian context to answer part of Q3.

Three elements of the research were explained in this chapter. First, the secondary data sources were identified. The secondary data for the global ICT services analysis was collected from the World Bank database, the IMF annual database, the ILO database, and the ITU database. Data from the Indonesian MCSME and BPS was gathered for the Indonesian context analysis.

Second, the econometric technique for the analyses was described. The models for the analyses were developed based on panel estimation incorporating the Cobb Douglass production function approach. Panel estimation has an advantage in that it can be used to examine dynamic changes such as technological change. Therefore, this approach was adopted for the study of the ICT services that represent technology. The models cover the basic model, the collaboration model and also the lag model.

Third, the secondary data for the analyses. The global data reveals that fixed telephone held the biggest share of ICT services, but it tends to be declining in developed and developing nations. Mobile telephone and other services that include Internet and Cloud Computing services are growing rapidly in both panels. Indonesia’s ICT services trend shows a different outcome to the global situation. In Indonesia, mobile telephone held the biggest portion of the ICT services capital. Thus, the growth pattern for Indonesia’s fixed telephone, mobile telephone and other services are similar to the global trend with the adjustment for the size of the mobile telephone market. For the time being, SMEs are the major contributor to the Indonesian economy. Micro enterprises were the biggest contributor, followed by small and medium enterprises.

The next chapter, Chapter 4, provides the cross-country analysis to study the influence of ICT services on the economy of developed and developing countries. In addition, this analysis also examines the relationships between ICT services capital with other growth variables. This analysis employed method, model and data as explained in this chapter. The aim of this analysis is to address Q1 and Q2.

Chapter 4 ICT Service Influence on Economic Growth

4.1 Introduction

This chapter presents a cross-country analysis of the influence that ICT services have on national economic growth. The analysis involved two groups of countries comprising 28 developed countries and 15 developing countries. It used the secondary data analysis method and the dataset described in Chapter 3. This analysis sheds light on the global trend in terms of the impact of ICT services on economic growth. The aim of this analysis was to understand the global trend of ICT services usage, and to answer Q1 and Q2 on the influence of ICT services on the economic growth with and without other economic growth variables. After capturing the global trend regarding the contribution of ICT services, the analysis focused specifically on Indonesia. The findings are presented in Chapter 5 and Chapter 7.

The organisation of this chapter is as follows. Section 4.2 describes the Unit Root test result from the first step of the analysis. Next, Section 4.3 explains the findings based on the panel estimation results.

4.2 Unit Root Test

The analysis of the impact of ICT services on economic growth began with the unit root test for all variables. Then, a panel regression technique was used to estimate the basic and the lag models. The models were investigated in two phases. In the first phase, data for an entire nation was investigated. The second phase involved the investigation of the per-population data. The root test method and the models are explained in Chapter 3.

To avoid any spurious effects, only those variables in the model that were stationary or $I(1)$ were allowed. In effect, short-run relationships were explored. The unit root test results of all variables at $\alpha = 5\%$, are presented in Table 4-1. For the developed nations, all variables are non-stationary, except, capital (K) and infrastructure capital ($KINF$). For the developing nations, K and ICT service capital ($KICTS$) are stationary while the other variables are non-stationary. The non-stationary variables appear in the model in a first-differenced format and the stationary variables are levelled.

Table 4-1 Cross Country Analysis Unit Root Test Result

	LLC	Breitung	IPS	ADF	PP
	Prob.	Prob.	Prob.	Prob.	Prob.
Developed					
Y	0.0089	1.0000	0.6110	0.5425	0.8584
K	0.0015	0.9986	0.0017	0.0011	0.0509
L	0.5327	0.9797	0.9867	0.8673	0.9353
$KICTS$	0.9988	1.0000	1.0000	0.9999	1.0000
$KINF$	0.0043	0.5066	0.0144	0.0038	0.0729
$K * KICTS$	0.9506	0.9847	0.0083	0.0011	0.5906
$L * KICTS$	0.4431	0.9523	0.7436	0.3996	0.8313
$KINF * KICTS$	0.1981	0.0694	0.9401	0.5342	0.0380
Developing					
Y	0.4755	0.9915	0.3942	0.1211	0.2631
K	0.0121	0.1896	0.0000	0.0000	0.0000
L	0.7094	0.0206	0.9884	0.4837	0.3458
$KICTS$	0.0000	0.9875	0.0000	0.0000	0.0000
$KINF$	0.2564	0.9942	0.0279	0.0263	0.0034
$K * KICTS$	0.1875	0.5614	0.6199	0.2846	0.8801
$L * KICTS$	0.8921	0.6308	0.5133	0.0029	0.0000
$KINF * KICTS$	0.1048	0.9170	0.1157	0.0293	0.4903

Note: This table reports the p-values for the unit root test. The null hypotheses of unit root apply for all the tests. All the variables are expressed in logarithmic form. LLC and Breitung assume common unit root, while the rest assume individual unit root process. Individual effects and individual linear trends are applied in all tests.

Table 4-2 presents the unit root test result for the per population variables, at α = 5%. For the group of developed nations, k and $kinf$ are stationary; whereas other variables are non-stationary. Meanwhile, for the developing nations, all variables are non-stationary, except k, $kicts$ and $kinf$. Next, the non-stationary variables are considered in the first difference forms, while others remained at the level form.

Table 4-2 Cross Country Analysis Unit Root Test Result – per population

	LLC	Breitung	IPS	ADF	PP
	Prob.	Prob.	Prob.	Prob.	Prob.
Developed					
y	0.0023	1.0000	0.2156	0.1783	0.6923
k	0.0003	0.978	0.0278	0.0115	0.8612
$icts$	0.6983	1.0000	0.0043	0.0014	0.9775
inf	0.0291	1.0000	0.0318	0.0013	0.0013
$k * kicts$	0.7427	0.9975	0.5488	0.4209	0.9996
$kinf * kicts$	0.5672	0.9934	0.7207	0.4351	0.8197
Developing					
y	0.0802	0.0295	0.141	0.1507	0.2892
k	0.0053	0.0571	0.0036	0.001	0.0370
$kicts$	0.0000	0.8767	0.0000	0.0000	0.0000
$kinf$	0.0238	0.7321	0.0015	0.0025	0.0697
$k * kicts$	0.7119	0.8642	0.2613	0.0231	0.9728
$kinf * kicts$	0.1475	0.9756	0.36	0.4334	0.4966

Note: This table reports the p-values for the unit root test. The null hypotheses of unit root apply for all the tests. All the variables are expressed in logarithmic form. LLC and Breitung assume common unit root, while the rest assume individual unit root process. Individual effects and individual linear trends are applied in all tests.

4.3 The Cross-Country Analysis Panel Estimation

The short run effect of this study is presented in Table 4-3. With respect to ICT services, there were three key findings. First, it was found that ICT services have a positive and significant effect in advanced nations. However, for developing nations the impact of ICT services is insignificant as the rate of adoption of this technology is still very low compared to that in developed nations. Second, there was evidence of the capital augmenting role of ICT services in both developed and developing nations. However, ICT services, in aggregate terms, were not seen as either a labour augmenting technology or an ICT infrastructure augmentation, for either grouping.

Table 4-4 presents Model 4-7 to Model 4-9 as per capita models. Unlike the previous set of models, Model 4-7to Model 4-9 comprise capital, output, and ICT services variables in per capita terms. Another difference is that the introduction of ICT infrastructure into this set of models given the importance of ICT services today in determining growth.

For ICT services, the key findings are as follows. First, ICT services have been a significant and positive growth factor for the developed nations but not for the developing nations. Second, ICT services when combined with capital, facilitate economic growth. Both these results are similar to those found using the previous set of models, Model 4-1 to Model 4-6. Third, for both panels, ICT infrastructure does not contribute to growth, on its own. For developed nations, this study found that higher ICT infrastructure investment has a significant effect on contemporaneous economic growth. Finally, for both developing and developed panels, when ICT services and ICT infrastructure are combined, their contribution to economic growth is positive and significant.

The first findings supported those earlier studies that found that (in-house) ICT have a positive influence on economic growth (Jorgenson and Stiroh, 2003; Thompson Jr. and Garbacz, 2007; Samoilenko and Osei-Bryson, 2008; Djiofak-Zebaze and Keck, 2009; Ketteni et al., 2011; Lee et al., 2012; Colombo et al., 2013; Forero, 2013; Dedrick et al.,2013). However, the results differed from Matambalaya and Wolf (2001); Kupussamy et al. (2013), Ishida (2015); Zelenyuk, V. (2014). Similar to the second findings, Samoilenko and Osei-Bryson (2008) also found that ICT capital worked together with total capital to boost economic growth. However, the third findings were not consistent with those of previous studies where ICT infrastructure investment itself was found to have a significant and positive impact on economic growth (Samoilenko and Osei-Bryson, 2008). Nonetheless, the third findings were consistent with those of studies conducted by Kuppusamy et al. (2008), where ICT infrastructure investment itself did not contribute significantly to the economic growth of several Asian countries such as Indonesia, The Philippines and Thailand.

Table 4-5 to Table 4-7 show the 0 to lag-4 models (Model 4-10 to Model 4-21). The key findings are as follow. First, ICT services were found to be positive and significant for lag -3 and lag -4 in the developing country panels, whilst the coefficients were very small. In contrast, they were insignificant for all lag models in the developed nation panels. Second, ICT services-augmented capital was confirmed as positive and significant for the developed nations economic growth at lag -1, and lag -3. On the other hand, in developing nations, ICT services did not augment capital in the lag models. Third, there is no evidence of ICT services-augmented labour and ICT infrastructure in the lag models, in both panels.

Table 4-8 shows the per-population 0 to lag -4 models (Model 4-22). From the model, the lag ICT services are an insignificant contributor to economic growth, both in developed and developing nations. However, at lag-4, ICT services augmented-capital is found to be significant and positive in the developed nation panels.

In some models for developing countries, the adjusted R^2 are low. The adjusted R^2 penalizes the loss of degrees of freedom that occurs when a model is expanded. Low adjusted R^2 indicates that the penalty is not sufficiently large to ensure that the criterion will necessarily lead the analyst to the correct model (Greene,2011). However, Figure 3-3 show that the data follow linear trend with some high variance. Therefore, the models are fit with the linear regression estimation.

Table 4-3 Cross Country Analysis - The Influence of ICT outsourcing services

This table reports coefficient and probability estimates and the model's adjusted R-squared. For Model **4-1** and Model **4-2**: $Y_{it} = \beta_1 K_{it} + \beta_2 KICTS_{it} + \beta_3 L_{it} + \varepsilon_{it}$; Model **4-3** and Model **4-5**: $Y_{it} = \beta_1 K_{it} * KICTS_{it} + \beta_2 L_{it} * KICTS_{it} + \varepsilon_{it}$. Model **4-3** and Model **4-5**interacts K_{it} and L_{it} variables with ICT services to make $(L_{it} * KICTS_{it})$ and $(K_{it} * KICTS_{it})$. Model **4-4**combines the traditional Solow model (Model **4-1**) with Model **4-3** to give the following representation: $Y_{it} = \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 K_{it} * KICTS_{it} + \beta_4 L_{it} * KICTS_{it} + \varepsilon_{it}$. In Model **4-6**, the model including $KINF$: $Y_t = \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 K_{it} * KICTS_{it} + \beta_4 L_{it} * KICTS_{it} + \beta_5 KINF_{it} * KICTS_{it} + \varepsilon_{it}$. In all models, ε_{it} accounts for the part of Y_{it} unexplained by the model.

	Model 4-1		Model 4-2		Model 4-3		Model 4-4		Model 4-5		Model 4-6	
	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Developed Countries												
C	0.0150	0.0000	-0.0413	0.0004	0.0159	0.0000	0.0254	0.0000	0.0062	0.8554	0.0621	0.3392
K	-0.0009	0.6024	0.0219***	0.0000			-0.0042	0.0000			-0.0117	0.4397
L	0.0042	0.6599	0.0034	0.6926			0.0041	0.5663			0.1807	0.2535
$KICTS$	0.4012***	0.0000	0.2063***	0.0000			0.2148***	0.0002			-1.0340	0.0527
$KINF$			-0.0308	0.0000							-0.0233	0.2617
$K * KICTS$					0.0524***	0.0000	0.0466***	0.0000	0.3863***	0.0000	0.4455***	0.0000
$L * KICTS$					0.0217***	0.0000	0.0008	0.8766	-0.0972	0.0000	-0.0412	0.3542
$KINF * KICTS$									-0.2358	0.0000	-0.2275	0.0000
$\overline{R^2}$	0.1850		0.2840		0.2857		0.3115		0.1317		0.1398	
Developing Countries												
C	0.0291	0.0001	0.0376	0.0000	0.0346	0.0000	0.0313	0.0000	1.6044	0.0332	1.1031	0.0834
K	0.0051	0.1720	0.0000	0.7437			0.0007	0.8534			0.0000	0.4277
L	-0.0591	0.1924	0.0000	0.8483			-0.0571	0.1847			0.0000**	0.0365
$KICTS$	0.0046	0.5032	0.0000	0.5112			-0.0810	0.1303			0.0000**	0.0279
$KINF$			0.0000	0.1826							0.0000**	0.0164
$K * KICTS$					0.0188	0.4023	0.0053	0.8352	0.0439***	0.0000	0.0545***	0.0000
$L * KICTS$					0.0006	0.3869	0.0105*	0.0934	0.0000	0.2979	0.0000**	0.0324
$KINF * KICTS$									0.0000	0.7106	0.0000	0.1281
$\overline{R^2}$	0.0127		0.0084		0.0017		0.0103		0.1205		0.2084	

Table 4-4 The Influence of ICT outsourcing services – Per Population

This table reports coefficient and probability estimates and the adjusted R-squared for Model 4-7 to Model 4-9. In Model 4-7: $y_{it} = \beta_1 k_{it} + \beta_2 kicts_{it} + \beta_3 kinf_{it} + \varepsilon_{it}$; and in Model 4-8: $y_{it} = \beta_1 k_{it} * kicts_{it} + \beta_2 kinf_{it} * kicts_{it} + \varepsilon_t$. Model 4-8 interacts k_{it} and $kinf_{it}$ variables with ICT services to make $(k_{it} * kicts_t)$ and $(kinf_{it} * kicts_{it})$. Model 4-9 combines the Model 4-7 with Model 4-8 to give: $y_{it} = \beta_1 k_{it} + \beta_2 kicts_{it} + \beta_3 kinf_{it} + \beta_4 k_{it} * kicts_{it} + \beta_5 kinf_{it} * kicts_{it} + \varepsilon_{it}$. In all models, ε_{it} accounts for the part of Y_{it} unexplained by the model.

	Model 4-7		Model 4-8		Model 4-9	
Developed	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
c	0.0592	0.0022	0.0179	0.0000	0.0735	0.0000
k	0.0044	0.3249			0.0004	0.9260
$kicts$	0.4453***	0.0000			0.1357*	0.0636
$kinf$	-0.0305	0.0004			-0.0300	0.0008
$k * kicts$			0.0706***	0.0000	0.0539***	0.0000
$kinf * kicts$			0.0124	0.1026	0.0110	0.1993
$\overline{R^2}$	0.1115		0.1318		0.1477	
Developing						
c	0.0173	0.0542	0.0226	0.0000	0.0325	0.0003
k	0.0049	0.1081			0.0022	0.4682
$kicts$	-0.0088	0.3468			-0.0291	0.0029
$kinf$	0.0093	0.3603			0.0237**	0.0264
$k * kicts$			0.0278***	0.0004	0.0365***	0.0000
$kinf * kicts$			0.0214*	0.0750	0.0171	0.1806
$\overline{R^2}$	0.0029		0.0738		0.0896	

Note: The blank cells mean that the variables are not included in the model

Table 4-5 The Influence of ICT outsourcing services (Lag-0 to -4)

These models apply a lag structure from 0-4 lags on all the single variables. For Model 4-10 to Model 4-13: $Y_{it} = \beta_1 \sum_n^0 K_{it} + \beta_2 \sum_n^0 L_{it} + \beta_3 \sum_n^0 KICTS_{it} + \beta_4 \sum_n^0 KINF_{it} + \beta_5 \sum_n^1 Y_{it} + \varepsilon_{it}$. For Model 4-10, Model 4-11, Model 4-12, and Model 4-13, n is equal to -1, -2, -3, and -4, respectively.

	Model 4-10		Model 4-11		Model 4-12		Model 4-13	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
Developed								
C	-0.2032	0.1023	-0.1921	0.1745	-0.2465	0.1326	-0.2042	0.2821
K	1.1758***	0.0000	1.8579***	0.0000	2.2383***	0.0000	2.6578***	0.0000
L	-0.0227	0.9119	0.0841	0.7082	0.1252	0.5982	-0.1628	0.5366
$KICTS$	-0.4806	0.2212	-1.2658	0.0049	-1.2190	0.0122	-1.4047	0.0098
$KINF$	-0.3045	0.0890	-0.3801	0.0523	-0.4125	0.0574	-0.4181	0.0763
$Y(-1)$	-0.0179	0.6953	-0.1056	0.0367	-0.0693	0.2092	-0.0644	0.3108
$K(-1)$	-1.1340	0.0000	-0.7822	0.0005	-1.4895	0.0000	-1.7463	0.0000
$L(-1)$	0.0449	0.8201	0.0116	0.9576	-0.0275	0.9094	-0.1563	0.5486
$KICTS(-1)$	-0.3507	0.3840	-0.8586	0.0533	-0.5516	0.2847	-0.7850	0.1698
$KINF(-1)$	0.0781	0.6725	0.2242	0.2821	0.3640	0.1221	0.2716	0.3072
$Y(-2)$			0.0076	0.8710	0.0756	0.1602	-0.0348	0.5888
$K(-2)$			-1.0405	0.0000	-1.4826	0.0000	-0.5405	0.2515
$L(-2)$			-0.0746	0.7146	-0.0439	0.8471	-0.1065	0.6754
$KICTS(-2)$			0.3316	0.4326	0.7044	0.1386	-0.3403	0.5680
$KINF(-2)$			0.2441	0.2153	0.2639	0.2428	0.1651	0.5321
$Y(-3)$					0.0337	0.5836	-0.1408	0.1239
$K(-3)$					0.7740***	0.0039	0.9489***	0.0111
$L(-3)$					0.1223	0.5647	0.0813	0.7343
$KICTS(-3)$					-0.3754	0.4224	-0.8633	0.1155
$KINF(-3)$					0.1429	0.5146	0.2025	0.4274
$Y(-4)$							0.0057	0.9292
$K(-4)$							-1.2708	0.0069
$L(-4)$							-0.2236	0.3832
$KICTS(-4)$							-0.8196	0.1163
$KINF(-4)$							0.1217	0.6262
$\overline{R^2}$	0.1114		0.1753		0.2230		0.2617	

Continued on the next page

	Model 7-10		Model 7-11		Model 7-12		Model 7-13	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
Developing								
C	0.0465	0.0000	0.0339	0.0000	0.0303	0.0000	0.0345	0.0001
K	-0.0002	0.4047	-0.0003	0.4704	-0.0002	0.6167	-0.0020	0.0354
L	0.0000	0.5973	0.0000	0.5622	0.0000	0.2414	0.0000**	0.0126
$ICTS$	0.0000	0.1954	0.0000	0.1590	0.0000	0.6622	0.0000	0.6006
INF	0.0000	0.5215	0.0000	0.1654	0.0000*	0.0704	0.0000	0.1741
$Y(-1)$	-0.2301	0.0005	-0.0871	0.2326	0.0531	0.4832	0.1828	0.0411
$K(-1)$	0.0000	0.7853	-0.0002	0.6815	-0.0005	0.3510	-0.0018	0.0066
$L(-1)$	0.0000	0.3259	0.0000	0.3146	0.0000	0.7668	0.0000	0.1642
$KICTS(-1)$	0.0000	0.3892	0.0000	0.0665	0.0000	0.7377	0.0000	0.1093
$KINF(-1)$	0.0000	0.5083	0.0000	0.9407	0.0000	0.8331	0.0000	0.7503
$Y(-2)$			0.1939	0.0046	0.0685	0.3366	0.0503	0.5133
$K(-2)$			0.0001	0.3156	0.0004	0.3840	0.0028***	0.0013
$L(-2)$			0.0000	0.6884	0.0000	0.3503	0.0000	0.1376
$KICTS(-2)$			0.0000	0.1012	0.0000	0.4564	0.0000	0.1318
$KINF(-2)$			0.0000	0.8906	0.0000	0.5541	0.0000	0.1909
$Y(-3)$					-0.0178	0.7906	-0.0272	0.7038
$K(-3)$					0.0002	0.2440	-0.0017	0.0161
$L(-3)$					0.0000	0.3630	0.0000	0.5410
$KICTS(-3)$					0.0000	0.2755	0.0000**	0.0112
$KINF(-3)$					0.0000*	0.0612	0.0000***	0.0003
$Y(-4)$							-0.0375	0.5777
$K(-4)$							0.0007*	0.0528
$L(-4)$							0.0000	0.7612
$KICTS(-4)$							0.0000**	0.0184
$KINF(-4)$							0.0000***	0.0064
$\overline{R^2}$	0.0431		0.0437		0.1263		0.1278	

Note: the blank cells mean that the variables are not included in the model

Table 4-6 The Influence of ICT outsourcing services- complementary effect (Lag-0 to -4)

These models apply a lag structure from 0-4 lags on all the complementary or joint variables. In Model 4-14 to Model 4-17 : $Y_{it} = \beta_1 \sum_n^0 K_{it} * KICTS_{it} + \beta_2 \sum_n^0 L_{it} * KICTS_{it} + \beta_3 \sum_n^0 KINF_{it} * KICTS_{it} + \beta_5 \sum_n^1 Y_{it} + \varepsilon_t$. For Model 4-14, Model 4-15, Model 4-16, and Model 4-17, n is equal to -1, -2, -3, and -4, respectively.

	Model 4-14		Model 4-15		Model 4-16		Model 4-17	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
Developed								
C	-0.0488	0.4431	-0.0671	0.3676	-0.1053	0.2426	-0.0273	0.7988
$K * KICTS$	1.1745***	0.0000	1.4990***	0.0000	1.8637***	0.0000	1.9910***	0.0000
$L * KICTS$	-0.2033	0.3070	-0.2653	0.2130	-0.4210	0.0714	-0.4246	0.0933
$KINF * KICTS$	-0.7511	0.0000	-0.8364	0.0000	-0.9808	0.0000	-1.0282	0.0000
$Y(-1)$	-0.0659	0.1738	-0.0417	0.4182	-0.0323	0.5666	0.0102	0.8672
$K * KICTS(-1)$	0.4764***	0.0046	0.2583	0.2135	0.2977	0.2352	0.0606	0.8342
$L * KICTS(-1)$	-0.1275	0.5076	-0.1603	0.4641	-0.1857	0.4362	-0.1345	0.6014
$KINF * KICTS(-1)$	-0.2126	0.1701	0.0040	0.9830	-0.1459	0.4965	-0.0828	0.7290
$Y(-2)$			0.0445	0.3863	-0.0060	0.9149	-0.0490	0.4179
$K * KICTS(-2)$			-0.5525	0.0063	-0.1151	0.6515	0.0935	0.7468
$L * KICTS(-2)$			0.0364	0.8567	0.0348	0.8807	-0.0019	0.9940
$KINF * KICTS(-2)$			0.3610**	0.0325	0.0715	0.7370	0.0748	0.7573
$Y(-3)$					-0.0656	0.3839	-0.0107	0.8981
$K * KICTS(-3)$					0.6711**	0.0161	0.4076	0.2266
$L * KICTS(-3)$					-0.0245	0.9087	-0.0277	0.9102
$KINF * KICTS(-3)$					-0.2549	0.2137	0.0201	0.9358
$Y(-4)$							0.1670	0.0426
$K * KICTS(-4)$							-1.0056	0.0026
$L * KICTS(-4)$							-0.0342	0.8943
$KINF * KICTS(-4)$							0.1272	0.5761
$\overline{R^2}$	0.1202		0.1613		0.1930		0.2226	
Developing								
C	1.7926	0.0261	1.4400	0.0916	1.0091	0.2914	0.4776	0.6256
$K * KICTS$	0.0399***	0.0005	0.0360***	0.0030	0.0294**	0.0268	0.0744***	0.0000
$L * KICTS$	0.0000	0.4842	0.0000	0.5049	0.0000	0.2581	0.0000	0.4121
$KINF * KICTS$	0.0000	0.2791	0.0000*	0.0652	0.0000	0.1385	0.0000	0.6341
$Y(-1)$	-0.0909	0.1045	-0.0217	0.7096	-0.0007	0.9911	-0.1521	0.0188
$K * KICTS(-1)$	-0.0001	0.9919	0.0034	0.7799	-0.0024	0.8662	-0.0082	0.5822
$L * KICTS(-1)$	0.0000	0.3728	0.0000	0.4551	0.0000	0.5513	0.0000	0.8726
$KINF * KICTS(-1)$	0.0000	0.2165	0.0000	0.3900	0.0000	0.4743	0.0000	0.8233
$Y(-2)$			-0.0191	0.7476	-0.0190	0.7725	-0.0400	0.5468

	Model 4-14		Model 4-15		Model 4-16		Model 4-17	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
$K*KICTS(-2)$			-0.0151	0.1211	-0.0206	0.1712	-0.0270	0.0986
$L*KICTS(-2)$			0.0000	0.9646	0.0000	0.6324	0.0000	0.3147
$KINF*KICTS(-2)$			0.0000	0.3324	0.0000	0.2697	0.0000	0.4239
$Y(-3)$					0.0726	0.2546	0.0981	0.1290
$K*KICTS(-3)$					-0.0101	0.3249	-0.0174	0.2416
$L*KICTS(-3)$					0.0000	0.9107	0.0000	0.8035
$KINF*KICTS(-3)$					0.0000	0.5029	0.0000	0.4372
$Y(-4)$							0.0482	0.4231
$K*KICTS(-4)$							-0.0192	0.0531
$L*KICTS(-4)$							0.0000	0.8016
$KINF*KICTS(-4)$							0.0000	0.7383
$\overline{R^2}$	0.1178		0.1046		0.0841		0.2269	

Note: the blank cells mean that the variables are not included in the model

Table 4-7 The Influence of ICT outsourcing services- complementary effect (Lag-0 to -4)

These models apply a lag structure from 0-4 lags on all the variables. In Model 4-18 to Model 4-21: $Y_{it} = \mathrm{C} + \beta_1 K_{it} + \beta_2 L_{it} + \ \beta_3 KICTS_{it} + \beta_4 KINF_{it} + \beta_5 K_{it} * KICTS_{it} + \beta_6 L_{it} * KICTS_{it} + \beta_7 KINF_{it} * KICTS_{it} + \beta_8 K_{nit} + \beta_9 L_{nit} + \ \beta_9 KICTS_{nit} + \beta_{10} KINF_{nit} + \beta_{11} K_{nit} * KICTS_{nit} + \beta_{12} L_{nit} * KICTS_{nit} + \beta_{18} KINF_{nit} * KICTS_{nt} + \varepsilon_{it}$.. For Model 4-18, Model 4-19, Model 4-20, and Model 4-21, n is equal to -1,-2, -3, and -4, respectively. Some variables are not included in some models, because it is nearly singular matrix if included.

	Model 4-18		Model 4-19		Model 4-20		Model 4-21	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
C	-0.1067	0.3927	-0.2491	0.0675	-0.3080	0.0212	-0.2217	0.1785
K	12.7007	0.8235	0.4872**	0.0278	0.1652***	0.0002	0.3704**	0.0328
$KICTS$	10.0306	0.8601	-2.4635	0.0001	-2.4353	0.0000	-2.4724	0.0006
$K * KICTS$	-10.9639	0.8473	1.6034***	0.0000	2.0376**	0.0031	1.9812***	0.0000
$L * KICTS$	0.0923	0.6553	0.1479	0.4972	-0.0841	0.8007	-0.0596	0.8157
$KINF * KICTS$	-0.3596	0.0413	-0.4241	0.0240	-0.4064	0.0000	-0.4797	0.0313
$Y(-n)$	-0.1016	0.0338	0.0790	0.1125	-0.1260	0.0237	0.0414	0.5536
$K(-n)$	-12.6761	0.8239	-0.4488	0.0450	-0.1140	0.8358	-0.3295	0.0576
$L(-n)$	-1.8303	0.0012	1.5307**	0.0107	-1.9213	0.3835	-0.0035	0.9961
$KICTS(-n)$	0.9779***	0.0000	-0.8532	0.0001	1.0005***	0.0000	-0.3414	0.1493
$KINF(-n)$	0.0272	0.8885	-0.0585	0.7673	0.1509	0.1289	-0.2241	0.3697
$K * KICTS(-n)$	0.1539	0.3969	0.1287	0.4932	0.0940***	0.0000	-0.0041	0.9858
$\overline{R^2}$	0.1656		0.2245		0.2376		0.2358	
Developing								
C	2.8688	0.0322	2.4730	0.0858	3.1889	0.0212	0.4871	0.7748
K	-0.0009	0.0039	-0.0003	0.1931	-0.0011	0.0002	-0.0024	0.0010
L	0.0000	0.7247	0.0000	0.2989	0.0000***	0.0000	0.0000***	0.0026
$KICTS$	0.0000	0.5934	0.0000	0.3698	0.0000***	0.0031	0.0000***	0.0019
$KINF$	0.0000**	0.0477	0.0000***	0.0076	0.0000	0.8007	0.0000***	0.0001
$K * KICTS$	0.0873***	0.0000	0.0578***	0.0002	0.0959***	0.0000	0.0797***	0.0000
$L * KICTS$	0.0000	0.7500	0.0000	0.3429	0.0000**	0.0237	0.0000	0.8633
$KINF * KICTS$	0.0000	0.7306	0.0000	0.9183	0.0000	0.8358	0.0000	0.3433
$Y(-n)$	-0.1838	0.0155	0.0912	0.2054	0.0548	0.3835	0.0517	0.4413
$K(-n)$	0.0004***	0.0024	0.0001	0.2455	0.0005***	0.0000	0.0006***	0.0019
$L(-n)$	0.0000***	0.0036	0.0000	0.6791	0.0000	0.1289	0.0000	0.4836
$KICTS(-n)$	0.0000	0.7206	0.0000	0.5631	0.0000***	0.0000	0.0000***	0.0018
$KINF(-n)$	0.0000	0.6580	0.0000	0.7046	0.0000***	0.0000	0.0000***	0.0015
$K * KICTS(-n)$	-0.0345	0.0126	-0.0301	0.0293	-0.0248	0.0444	-0.0256	0.0638
$L * KICTS(-n)$	0.0000	0.9719	0.0000	0.6079	0.0000*	0.0569	0.0000	0.9256
$KINF * KICTS(-n)$	0.0000	0.9421	0.0000	0.5987	0.0000	0.7319	0.0000	0.5442
$\overline{R^2}$	0.2764		0.1750		0.3864		0.2845	

Note: the blank cells mean that the variables are not included in the model

Table 4-8 The Influence of ICT outsourcing services – Per Population (Lag-0 to -4)

These models apply a lag structure from 0-4 lags on all the per capita variables. In Model 4-22 : $y_{it} = \beta_1 \sum_4^0 k_{it} + \beta_2 \sum_4^0 kinf_{it} + \beta_3 \sum_4^0 kicts_{it} + \beta_4 \sum_4^0 k_{it} * kicts_{it} + \beta_5 \sum_4^0 kinf_{it} * kicts_{it} + \varepsilon_{it}$. This model also interacted k_{it} and $kinf_{it}$ variables with ICT services to make $(k_{it} * kicts_{it})$ and $(kinf_{it} * kicts_{it})$. In all models, ε_{it} accounts for the part of y_{it} unexplained by the model. Some variables are not included in the model, because it will create circular matrix if the variable is included.

Model 4-22

Variable	Developed		Developing		Variable	Developed		Developing	
	Coeff.	Prob.	Coeff.	Prob.		Coeff.	Prob.	Coeff.	Prob.
c	0.0347	0.0166	0.0257	0.0814	$y(-3)$	-0.1627	0.0023	0.1212	0.0717
k	0.7022***	0.0000	0.0090	0.8656	$k(-3)$	0.0853	0.5646	-0.0516	0.4552
$kicts$	0.7478***	0.0000	0.0217	0.8377	$kicts(-3)$	-0.0351	0.7721	-0.0656	0.6117
$kinf$	0.0353	0.7094	0.1098***	0.0074	kinf(-3)	-0.0035	0.9730	-0.0074	0.8541
$k * kicts$	-0.1409	0.0000	0.1228***	0.0014	$k * kicts(-3)$	0.0193	0.5594	0.0621*	0.0528
$inf * kicts$	-0.0065	0.8533	-0.0641	0.0238	$kinf * kicts(-3)$	-0.0124	0.6763	-0.0365	0.1480
$y(-1)$	-0.2123	0.0000	-0.2043	0.0028	$y(-4)$	-0.0191	0.3398	-0.0210	0.7237
$k(-1)$	-0.4363	0.0045	0.0453	0.5198	$k(-4)$	-0.0109	0.9073	0.1692***	0.0007
$kicts(-1)$	0.1752	0.1952	0.0150	0.9078	$kicts(-4)$	-0.1742	0.0005	0.1324	0.1422
kinf(-1)	0.0272	0.8232	-0.1524	0.0042	kinf(-4)	-0.0307	0.6818	-0.0475	0.1196
$k * kicts(-1)$	-0.0341	0.3426	-0.0150	0.6708	$k * kicts(-4)$	0.0295***	0.0003	0.0201	0.1614
$kinf * kicts(-1)$	-0.0213	0.5074	0.0369	0.1692	$kinf * kicts(-4)$	0.0010	0.8525	-0.0297	0.0381
$y(-2)$	-0.1545	0.0004	-0.0725	0.2911	$\overline{R^2}$	0.4742		0.3259	
$k(-2)$	-0.3364	0.0286	-0.1845	0.0100					
$kicts(-2)$	-0.0408	0.7583	-0.0868	0.4913					
kinf(-2)	-0.0422	0.6912	0.0962**	0.0303					
$k * kicts(-2)$	0.0377	0.2771	0.0484	0.1323					
$kinf * kicts(-2)$	-0.0165	0.5661	-0.0428	0.0912					

Note: the blank cells mean that the variables are not included in the model

4.4 Summary

This chapter examined the influence of ICT services on national economic growth from the global perspective as well as the Indonesian context. The findings from the analyses answer Q1 and Q2. From the global perspective, there are four key findings. First, ICT services have a positive and significant impact on the economic growth of developed countries, but not on that of developing countries. Second, capital augmenting the ICT services role both in developed and in developing nations. Third, ICT infrastructure has a significant impact on developing nations economic growth, either on its own or through collaboration with the ICT services. Finally, in developing nations, the impact of ICT services from the previous three to four years is influencing the current national economic growth, despite the effect being small. Meanwhile, in developed nations, capital augmenting the ICT services contributed to the national economy at lag -1 and lag-3.

The next chapter presents the analysis pertinent to the Indonesian context. The aim of this analysis is to investigate the impact of ICT services on Indonesia's economic growth. This analysis is similar to the cross-country analysis explained in this chapter, thus the data is time series data for Indonesia only. Additionally, Chapter 5 also presents an analysis of secondary data for the investigation of the SME impact on the Indonesian economy.

Chapter 5 ICT Services and SME Impact on Indonesia's Economy

5.1 Introduction

This chapter is devoted to an investigation of the ways in which ICT services and SMEs impact on Indonesia's economic growth. Secondary data analysis is the research method applied, as explained in Chapter 3. The findings address part of Q3 regarding the impact of ICT services on the Indonesian economy through their utilisation by SMEs.

The remainder of this chapter is organised as follows. Section 5.2 describes the secondary data analysis for the examination of ICT services influence on Indonesia's economy. The unit root test and findings based on the panel estimation of the contribution of SMEs to Indonesia's economic growth are explained in Section 5.3.

5.2 The Indonesian ICT Services

The models in this analysis have been developed using the framework and econometric technique as explained in Section 3.3. Hence, the time series data is specific to Indonesia, covering the period 1970 to 2013 (see Section 3.4.2).

5.2.1 Unit Root test

Table 5-1 provides the result of the ADF unit root test for this analysis. None of the variables, in aggregate and per capita terms, was stationary or *I(1)* at α=5%. Next, all of the variables are considered in a first difference form in the models.

5.2.2 Estimation Result

As seen in Table 5-2 (Model 5-1 to Model 5-3ICT was found to significantly and positively influence Indonesia's economic growth. It also augmented capital to grow Indonesia's economy.

Table 5-1 Unit Root Test

Variable	Prob.*	Variable - per population	Prob.*
Y	0.1019	y	0.1264
K	0.4857	k	0.5246
L	0.5513	$icts$	0.2737
$KICTS$	0.2468	inf	0.3553
$KINF$	0.3424	$k * icts$	0.4358
$K * KICTS$	0.3970	$inf * icts$	0.4134
$L * KICTS$	0.4537		
$KINF * KICTS$	0.3916		

*Note: *MacKinnon (1996) one-sided p-values.*

Although it was found to be significant when in collaboration with the labour capital, the coefficient was very small (the coefficient value is less than 0.0000), and so this evidence is negligible. Similar findings also suggest that in the per-population models presented in Table 5-3 (Model 5-4 to Model 5-6), where ICT services, either by themselves or augmented with capital, these have a significant and positive influence on Indonesia's economic growth. By contrast, there is no evidence that ICT services have augmented the infrastructure capital. These findings are similar to those for the developed nation panels (see Chapter 4).

Because there was no significant role or labour capital in the model, the lag models for the ICT services role in Indonesia's economic growth was calculated only for the per-population variable. Furthermore, due to an insufficient number of observations, the lag models could be calculated only up to lag -2. The lag model results are presented in Table 5-4 Estimation – Lag (0 to -2) (Model 5-7 and Model 5-8). The results confirm that ICT infrastructure augmented ICT services at lag -1. It can be argued that the infrastructure development in Indonesia might generate ICT services utilisation in the same year, but it lags for one year. On the other hand, the findings from these models do not confirm the previous findings for the global trend. The lag models of the global evidence reveal that in both developed and developing nations, ICT infrastructure does not collaborate with ICT services, although capital is augmenting ICT services capital.

Table 5-2 Indonesia context, the ICT Services Role

This table reports coefficient and probability estimates and the model's adjusted R-squared for Model 5-1 to Model 5-3: $Y_t = \beta_1 K_t + \beta_2 KICTS_t + \beta_3 KINF_t + \varepsilon_t$ (Model 5-1); $Y_t = \beta_1 K_t KICTS_t + \beta_2 L_t KICTS_t + \beta_3 KINF_t KICTS_t + \varepsilon_t$ (Model 5-2). Model 5-2 interacts K_t , L_t, and $KINF_t$ variables with ICT services to give the model $(K_t * KICTS_t)$, $(L_t * KICTS_t)$ and $(KINF_t * KICTS_t)$. Model 5-3combines Model 5-1 with Model 5-2to give the following representation: $Y_t = \beta_1 K_t + \beta_2 KICTS_t + \beta_3 KINF_t + \beta_4 K_t * KICTS_t + \beta_5 KINF_t * KICTS_t + \varepsilon_t$ (Model 5-3). L_t is not included in Model 5-1and Model 5-3, because of the insufficient number of observation. $KINF_t * KICTS_t$ is not included in Model 5-3, because it causes a circular matrix. In all models, ε_t accounts for the part of Y_t unexplained by the model.

	Model 5-1		Model 5-2		Model 5-3	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
C	0.0164	0.7193	15.2019	0.0361	-0.0143	0.7325
K	0.0075	0.9717			0.1315	0.5072
$KICTS$	0.3612**	0.0196			0.1074	0.5947
$KINF$	-0.0112	0.8103			-0.0053	0.8967
$K * KICTS$			0.8522***	0.0027	0.3374**	0.0350
$L * KICTS$			-0.8146	0.0619	0.0000**	0.0342
$KINF * KICTS$			-0.0311	0.5658		
$\overline{R^2}$	0.1152		0.9866		0.4461	

Note: the blank cells mean that the variables are not included in the model

Table 5-3 Indonesian context, the ICT Services Role – per population

This table reports coefficient and probability estimates and the model's adjusted R-squared for Model 5-4 to Model 5-6. In Model 5-4: $y_t = \beta_1 k_t + \beta_2 kicts_t + \beta_3 kinf_t + \varepsilon_t$; and in Model 5-5: $y_t = \beta_1 k_t * kicts_t + \beta_2 kinf_t * kicts_t + \varepsilon_t$. Model 5-5 interacts k_t , and $kinf_t$ variables with ICT services to give the model $(k_t * kicts_t)$, and $(kinf_t * kicts_t)$. Model 5-6 combines Model 5-4 with Model 5-5 to give the following representation: $y_t = \beta_1 k_t + \beta_2 kicts_t + \beta_3 kinf_t + \beta_4 k_t * kicts_t + \beta_5 kinf_t * kicts_t + \varepsilon_t$. In all models, ε_t accounts for the part of y_t unexplained by the model.

	Model 5-4		**Model 5-5**		**Model 5-6**	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
c	0.0048	0.8901	4.5524	0.0000	4.9787	0.0000
k	0.2124	0.1107			-0.3007	0.0901
$kicts$	0.3155**	0.0161			0.1714	0.1581
$kinf$	-0.0006	0.9890			-0.0612	0.1431
$k * kicts$			0.2351***	0.0000	0.1766***	0.0000
$kinf * kicts$			0.0227	0.5898	0.0284	0.4091
$\overline{R^2}$	0.1998		0.9097		0.8393	

Note: The blank cells mean that the variables are not included in the model

Table 5-4 Estimation – Lag (0 to -2)

The models apply a lag structure from 0-2 lags on all of the variables: $y_t = \beta_1 \sum_n^0 k_t + \beta_2 \sum_n^0 kinf_t + \beta_3 \sum_n^0 kicts_t + \beta_4 \sum_n^0 k_t * kicts_t + \beta_5 \sum_n^0 kinf_t * kicts_t + \beta_6 \sum_n^1 y_t + \varepsilon_t$, where n is equal to -1, and -2 for Model 5-7 and Model 5-8, respectively. These models also interacted k_t and $kinf_t$ variables with ICT services to make $(k_t * kicts_t)$ and $(kinf_t * kicts_t)$. In all models, ε_t accounts for the part of y_t unexplained by the model.

	Model 5-7		Model 5-8	
	Coeff.	Prob.	Coeff.	Prob.
c	2.2591	0.1672	2.8143	0.4196
k	-0.2499	0.1468	-0.1488	0.5799
$kicts$	37.4379**	0.0294	51.3779	0.7811
$kinf$	37.4667**	0.0304	51.2994	0.7817
$k * kicts$	0.3894**	0.0666	0.3563	0.2549
$kinf * kicts$	-37.4476	0.0304	-51.2845	0.7817
$y(-1)$	0.0605	0.8147	-0.2002	0.7577
$k(-1)$	-0.1944	0.2056	-0.2678	0.3259
$kicts(-1)$	-0.2991	0.1602	-13.3455	0.9365
kinf(-1)	-0.0729	0.0639	-13.0297	0.9379
$k * kicts(-1)$	-0.1060	0.6190	0.0666	0.8932
$inf * kicts(-1)$	37.5468**	0.0301	64.3816	0.8542
$y(-2)$			0.1736	0.8019
$k(-2)$			-0.1041	0.6882
$kicts(-2)$			-0.0746	0.8505
$kinf(-2)$			-0.0388	0.5533
$k * kicts(-2)$			-0.1581	0.6429
$kinf * kicts(-2)$			-12.9510	0.9383
$\overline{R^2}$	0.8852		0.7963	

Note: Lag model can be calculated only up to lag-2, due to insufficient data. The blank cells mean that the variables are not included in the model.

5.3 The role of SMEs in Indonesia's Economy

The methodology used for the analysis in this section is similar to that of the cross-country analysis in Chapter 4. It applied the Cobb-Douglass production function approach and the panel estimation method. It used secondary data, for the period of 2003 to 2013. Details of the method, models and data used for this analysis are presented in Chapter 3. The result of the unit root test and findings based on the panel estimation models are reported.

5.3.1 Unit Root Test

The LLC, Breitung, IPS, ADF and PP unit root test results of the variables in the analysis of the SME role in Indonesia's economic growth are reported in Table 5-5. The results, at α=5%, reveal that only Y is not stationary, whereas the other variables are stationary. Then Y is considered at the first difference form, while L and K are at the levelled form.

Table 5-5 Indonesian SME Role, Unit Root Test

	LLC Prob.	Breitung Prob.	IPS Prob.	ADF Prob.	PP Prob.
Y	0.0000	0.0970	0.0000	0.0000	0.0000
K	0.0000	0.0680	0.1550	0.1610	0.0950
L	0.1390	0.5240	0.9370	0.9750	0.9940

Note: This table reports the p-values for the unit root test. The null hypotheses of unit root apply to all the tests. All the variables, are expressed in logarithmic form. LLC and Breitung assume common unit root, while the rest assume individual unit root process. Individual effects and individual linear trends are applied in all tests.

5.3.2 Estimation Result

The panel estimation results of the Indonesian SME influence on national economic growth are displayed in The lag effect models of the SMEs influence on the Indonesia's economic growth are shown in Table 5-7 and Table 5-8 (Model 5-11 to Model 5-18). The results strongly indicate that the SME total capital played a significant role in the economic growth at lag -1. In addition, total capital also had a significant positive role at lag -2. This finding may explain that SMEs total capital impacts on the output more slowly than does the labour capital. Furthermore, capital augmenting labour was found to be significant at the lag -3 model.

Table 5-6 (Model 5-9 and Model 5-10) show that SMEs significantly contribute to Indonesia's economic growth through labour. In addition, labour also augments total capital to grow the national economy. These findings reveal that labour capital plays a more significant role in SMEs, compared with the total capital. A possible explanation for this might be due to difficulties in accessing finance; Indonesia's SMEs empower the labour capital to run the business (World Bank, 2015b).

The lag effect models of the SMEs influence on the Indonesia's economic growth are shown in Table 5-7 and Table 5-8 (Model 5-11 to Model 5-18). The results strongly indicate that the SME total capital played a significant role in the economic growth at lag -1. In addition, total capital also had a significant positive role at lag -2. This finding may explain that SMEs total capital impacts on the output more slowly than does the labour capital. Furthermore, capital augmenting labour was found to be significant at the lag -3 model.

Table 5-6 Indonesia SMEs Role, Panel Estimation

This table reports coefficient and probability estimates and the model's adjusted R-squared for Model 5-9 and Model 5-10: $Y_{it} = \beta_1 K_{it} + \beta_2 L_{it} + \varepsilon_{it}$ (Model 5-9); $Y_{it} = \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 K_{it} * L_{it} + \varepsilon_{it}$ (Model 5-10). K_t , and L_t are gross capital, and labour capital, respectively. Model 5-10 interacts K_{it} and L_{it} to give the model $(K_{it} L_{it})$. In all models, ε_{it} accounts for the part of Y_{it} unexplained by the model.

	Model 5-9		Model 5-10	
	Coeff.	Prob.	Coeff.	Prob.
C	13.5994	0.0000	-0.2656	0.9297
K	0.0265	0.8594	-0.1119	0.3408
L	0.9349*	0.0879	0.2009	0.6424
$K * L$			0.3912***	0.0001
$\overline{R^2}$	0.0377		0.4545	

Note: The blank cells mean that the variables are not included in the model. (***) α=1%, (**)α=5%,(*) α=10%

Table 5-7 Indonesia SMEs role, panel Estimation – Lag (0 to -4) models

These models apply a lag structure from 0-4 lags on all the variables: $Y_{it} = \beta_1 \sum_n^0 K_{it} + \beta_2 \sum_n^0 L_{it} + \beta_3 \sum_n^1 Y_{it} + +\varepsilon_{it}$ (Model 5-11 to Model 5-14). For Model 5-11, Model 5-12, Model 5-13, and Model 5-14, n is equal to -1, -2, -3, and -4, respectively. In all models, ε_{it} accounts for the part of Y_{it} unexplained by the model.

	Model 5-11		Model 5-12		Model 5-13		Model 5-14	
	coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
C	0.0393	0.9252	0.0206	0.9523	-0.0122	0.9462	-0.4734	0.0385
K	-0.0963	0.0022	-0.1933	0.1732	-0.4175	0.0006	-0.2792	0.1054
L	0.0922	0.3058	-0.0262	0.6559	0.1106	0.3947	0.2864	0.2132
$Y(-1)$	1.0081	0.0000	1.0260	0.0000	0.8888	0.0001	0.2047	0.4297
$K(-1)$	0.0183	0.4884	0.0771***	0.0053	0.3696***	0.0027	0.2495*	0.0911
$L(-1)$	-0.0453	0.5424	-0.0176	0.7630	-0.0282	0.2910	-0.3190	0.0572
$Y(-2)$			-0.0150	0.9342	-0.5394	0.0153	-0.3078	0.1623
$K(-2)$			-0.0074	0.6972	-0.0484	0.0166	0.1583	0.2018
$L(-2)$			-0.0764	0.1168	0.0471	0.0988	-0.0053	0.8096
$Y(-3)$					0.6719	0.0002	0.8204	0.0194
$K(-3)$					-0.0063	0.4760	0.0188	0.4946
$L(-3)$					0.0119	0.6273	-0.0181	0.3390
$Y(-4)$							0.3518	0.1435
$K(-4)$							0.0111	0.1311
$L(-4)$							0.0009	0.9445
$\overline{R^2}$	0.9870		0.9942		0.9990		0.9998	

Note: The blank cells mean that the variables are not included in the model. (***) α=1%, (**)α=5%,(*) α=10%

Table 5-8 Indonesian SMEs' role, panel estimation – complementary variables and lag (-0 to -4) models

These models apply a lag structure from 0-4 lags on all the variables: $Y_{it} = \mathrm{C} + \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 K_{it} * L_{it} + \beta_4 Y_{nit} + \beta_5 L_{nit} + \beta_6 K * L_{nit} + \varepsilon_{it}$ (35-38). For Model 5-15, Model 5-16, Model 5-17, and Model 5-18, n is equal to -1, -2, -3, and -4, respectively. In all models, ε_{it} accounts for the part of Y_{it} unexplained by the model.

	Model 5-15		Model 5-16		Model 5-17		Model 5-18	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
C	-0.5943	0.3556	-1.0776	0.1105	-0.9453	0.0997	-1.1820	0.1427
K	-0.0796	0.0151	0.1692	0.4107	-0.2511	0.2325	-0.5163	0.0813
L	0.0700	0.4359	-0.0876	0.4518	-0.1138	0.7112	0.1909	0.6829
$K * L$	0.0563	0.2009	0.0795	0.2466	0.0866*	0.0849	0.0837	0.2817
$Y(-n)$	0.9079	0.0000	0.9255	0.0000	0.8661	0.0000	0.8112	0.0001
$K(-n)$	0.0212	0.4166	0.0390*	0.0778	0.0161	0.3853	0.0239	0.3609
$L(-n)$	-0.0449	0.5395	-0.1010	0.2180	-0.0366	0.6046	-0.0155	0.8606
$K * L(-n)$	0.0655	0.2000	-0.0138	0.6798	0.0048	0.8224	0.0399	0.2948
$\overline{R^2}$	0.9845		0.9829		0.9894		0.9816	

Note: The blank cells mean that the variables are not included in the model. (***) α=1%, (**)α=5%,(*) α=10%

5.4 Summary

This chapter examined the influence of ICT services on Indonesia's economic growth. The findings reveal that ICT services positively contribute to the growth of Indonesia's economy. The evidence shows that ICT services are influential both on their own and together with total capital. These findings are similar to the results for the panels of developed nations (see Chapter 4). However, the lag models for Indonesia demonstrate findings that differ from the global trend. The previous year ICT services capital augmenting infrastructure capital positively influence Indonesia's economic growth.

Additionally, this chapter also explained the analysis of the SME influence on Indonesia's economy. The findings confirm that SMEs contribute to Indonesia's economic growth through labour capital, either the labour capital by itself or through collaboration between labour capital and the total capital. Furthermore, the lag -1 and lag -2 SME total capital by itself also positively contribute to the current economic growth. Further analysis adds to the findings from the investigation of the ICT services influence on SMEs, explained in the Chapter 7, thereby addressing Q3.

The next chapter demonstrates the second research method, that is, the primary data analysis applied in this study. It covers the primary data collection methodology and process, the econometric technique and models. This method is used to investigate the influence of ICT services on SMEs.

Chapter 6 Primary Data: ICT Services and Indonesia's SMEs

6.1 Introduction

A survey is a research method used to collect quantitative data from samples, conducted for the purpose of exploration and explanation research. Not only does it involve the collection of data, but also the data is compiled and analysed and the results are reported. The secondary data that was needed to examine the impact of ICT services on SME productivity, ICT services and Cloud Computing adoption factors in SMEs that addressed Q3, Q4 and Q5 was not available in the literature. Therefore, a field survey was carried out to gather the data and information needed for this research.

This chapter is organised as follows. Section 6.2 demonstrates the primary data collection method. Section 6.3 describes the field survey. Next, Section 6.4 presents the primary data for the examination of the ICT services influence on SMEs. Finally, the primary data used for the ICT services adoption analyses are presented in Section 6.5.

6.2 Primary Data Collection: Field Survey

The field survey is a research method involving the collection of data from samples of a large population, conducted for the purpose of explorative and explanatory research (Creswell, 2014). It involves not only collecting the data, but also compiling it, analysing the results and report writing. Questionnaires and structured interviews are also tools used, with questionnaires being most commonly used (Fowler 2014). Such research needs data from field surveys, because the secondary data that is generally available is not sufficient to explore and explain certain research questions.

The advantages of this method are multifaceted, efficient and generalizable. Compared to secondary analysis, surveys are more flexible in term of data gathering. Surveys are efficient because it is assumed that probability sampling represents a wide range of population, and thus it can reduce costs and time (Fowler 2014). Even so, one must consider the minimization of the risk of: (1) observation error: deviation of observed scores from true scores; and (2) non-observation error: failure to include other samples (Fowler 2014).

Due to the unavailability of the required data from the secondary data sources, for this research, a field survey was conducted. The field survey was conducted to gather detailed data for quantitative analysis and to identify the key factors related to the proposed algorithm. The objective of primary data analysis in this research is to examine the impact of ICT services on the Indonesian economy through ICT services utilisation by SMEs, and the influence of the adoption of ICT services, specifically Cloud Computing, on SMEs. The primary data analysis relates to Q3, Q4 and Q5. The overall results and recommendations are then formulated to achieve the main objective, that is, to investigate the role of ICT services in improving SME productivity and boosting Indonesia's economic growth.

6.2.1 Survey Design

The design of a survey is part of the research method development in stage 1 of the research (see Chapter 1, Section1.5). This includes: questionnaire design; respondent selection; survey procedure design; and human ethics approval.

6.2.1.1 Questionnaire Design

Questionnaires and structured interviews are often used, although questionnaires are the most favoured (Fowler, 2014). In this research, structured questionnaires were used to explore the utilisation of ICT services by Indonesian SMEs. The questionnaires were designed to comprehensively capture the research objectives. Effort was put into making the questionnaire attractive (neat, clear, clean and uncluttered) and easily understood by respondents. Given the sample population, the questionnaire was translated into Indonesian. A back-to-back translation from English to Indonesian to English was carried out to ensure that the questionnaire had not been misinterpreted (Triandis, 1983).

It is necessary to conduct a pilot test of a questionnaire prior to beginning any real field survey (Fowler, 2014). Before the survey was conducted, the questionnaire was pre-tested and refined. A test was done by a volunteer, who is an Indonesian entrepreneur. Next, a test was carried out by those who would be conducting the surveys ("the surveyors"). The surveyors were asked to answer the questionnaire, taking the role of actual respondents. This was also to test whether the surveyors had understood the questionnaire clearly, or not. The last test was a pilot test carried out with 10 SMEs in Bandung, to test whether real respondents could understand the questions. The questionnaire was revised and refined according to the feedback from each pilot test, though no significant revisions to the main content of the questionnaire were necessary.

Below is a brief description of the contents of the questionnaire used in this survey (the full questionnaire is provided in Appendix A2 and Appendix A3):

Section A: Demographic data

A.1 "About yourself". This section asked the respondent about his or her job title, authority , gender, age and education

A.2 "About your company". Questions related to the respondent's industry sector, business, length of time in the industry, branches, competitors, innovation and R&D.

Section B: "ICT". This section included questions about the current and future usage of ICT and ICT services.

Section C: "Cloud computing". Specific questions about the current and future use of cloud computing.

Section D: "Economic outlook". This section sought the SMEs' knowledge of and opinion about current and future economic issues influencing the business.

Section E: "Financial Performance"

E1: "Historical Financial Performance (1998-2014)". Financial items covered were: assets, revenue, expenses, investment, ICT and ICT services expenditure from1998 to 2014.

E.2: "Future Financial Projection (2015-2020)". This section asked for predictions of items in section E1 over the next five years.

Section F: "Labour"

F.1 "Historical Labour Data (1998-2014)". This section elicited employee data including number of employees, age, educational background and hours worked over the period 1998 to 2014.

F.2 "Future Labour Data (2015-2020)". This section asked for predictions regarding items in section F.1 over the next five years.

6.2.1.2 Respondent Selection

The selection of survey respondents is critical to primary data collection. It was crucial that the respondent selected was the key person who had the authority and ability to answer the questions correctly. In this survey, valid respondents could be the business owner, decision maker, financial manager or IT manager of the firm. The firms were randomly selected from the SMEs listed in www.smartbisnis.co.id, from the Yellow Pages or from several business centers.

Limitations of this research were both time available and the cost of conducting the survey all over Indonesia. Therefore, survey respondents were selected from four Indonesian cities. The cities were selected based on the regional GDP contributions, averaged between 2005 and 2013. Cities were grouped into three clusters representing high growth, medium to high growth and medium growth. The four cities selected were:

1. Jakarta, a representative of a high growth city. The Special Capital District of Jakarta contributes 16% to Indonesia's GDP.
2. Bandung, the capital city of West Java province, is also a representative of a high growth city. The province of West Java contributes around 14% to Indonesia's GDP.
3. Semarang, the capital city of the province of Central Java, represents medium to high growth cities. The province of Central Java contributes around 8% to Indonesia's GDP.

4. Denpasar, the capital city of the province of Bali, represents medium growth cities. The province of Bali contributes around 1.25% to Indonesia's GDP.

6.2.2 Survey Procedure

Surveys can be conducted through: mail, group survey, by phone, in person or face-to-face and electronically (e-mail and web survey) (Creswell 2014). For this study, face-to-face, e-mail and phone survey techniques were used. Group surveys were not appropriate for this research, because the objective of the survey was to obtain individual business data. Web surveys were not used in this survey given the low possibility of SMEs accessing the Internet for survey purposes and the complexity and the length of the questionnaire.

Detailed and clear guidelines on how to conduct the survey were developed for surveyors. Figure 6-1 explains the survey procedure as the surveyor guidelines.

Group-chatting through email and WhatsApp was utilised to allow for collaboration between surveyors, survey supervisors and the researcher. Problems and successful strategies found during the survey were discussed in this way. Face-to-face meetings and conference calls were also conducted occasionally to ensure the survey was being properly conducted.

6.2.3 Ethical Issues

Ethical issues, especially with regard to confidentiality, also needed to be considered. Respondent consent or anonymity were possible strategies (Creswell 2014). The research project was reviewed and approved by the RMIT University Human Research Ethics Committee (project number 1000360), the ethical guidelines of RMIT University were strictly followed.

6.3 The Field Survey

The field survey for primary data collection was carried out from March to November 2015. Structured questionnaires were sent to 700 SMEs in four cities: Jakarta (300), Bandung (200), Semarang (100) and Denpasar (100). The survey was conducted by Bandung Technopark, an institution that had the capability and experience to conduct field surveys of Indonesian SMEs. respondents

Table 6-1: Questionnaire distribution

Survey Methods	**Jakarta**	**Bandung**	**Semarang**	**Denpasar**	**Total**
Email survey	30	30	15	15	*90*
Phone survey	20	20	10	10	*60*
Face-to-face	250	150	75	75	*550*
Total	***300***	***200***	***100***	***100***	***700***

Table 6-1 shows and the number of respondents who were sent the questionnaire. 420 (60%) questionnaires were returned with 399 (57%) providing valid data. The returned questionnaires were from face-to-face interviews. None of the respondents responded to email and web survey requests, and only a few respondents responded to phone calls. Most of the potential respondents did not participate because either they were too busy or they were not survey targets (not the owner / CEO / ICT manager / finance manager). Some potential respondents contacted by phone, agreed to participate, asked for the questionnaire to be sent by email, but failed to respond to the emailed questionnaires.

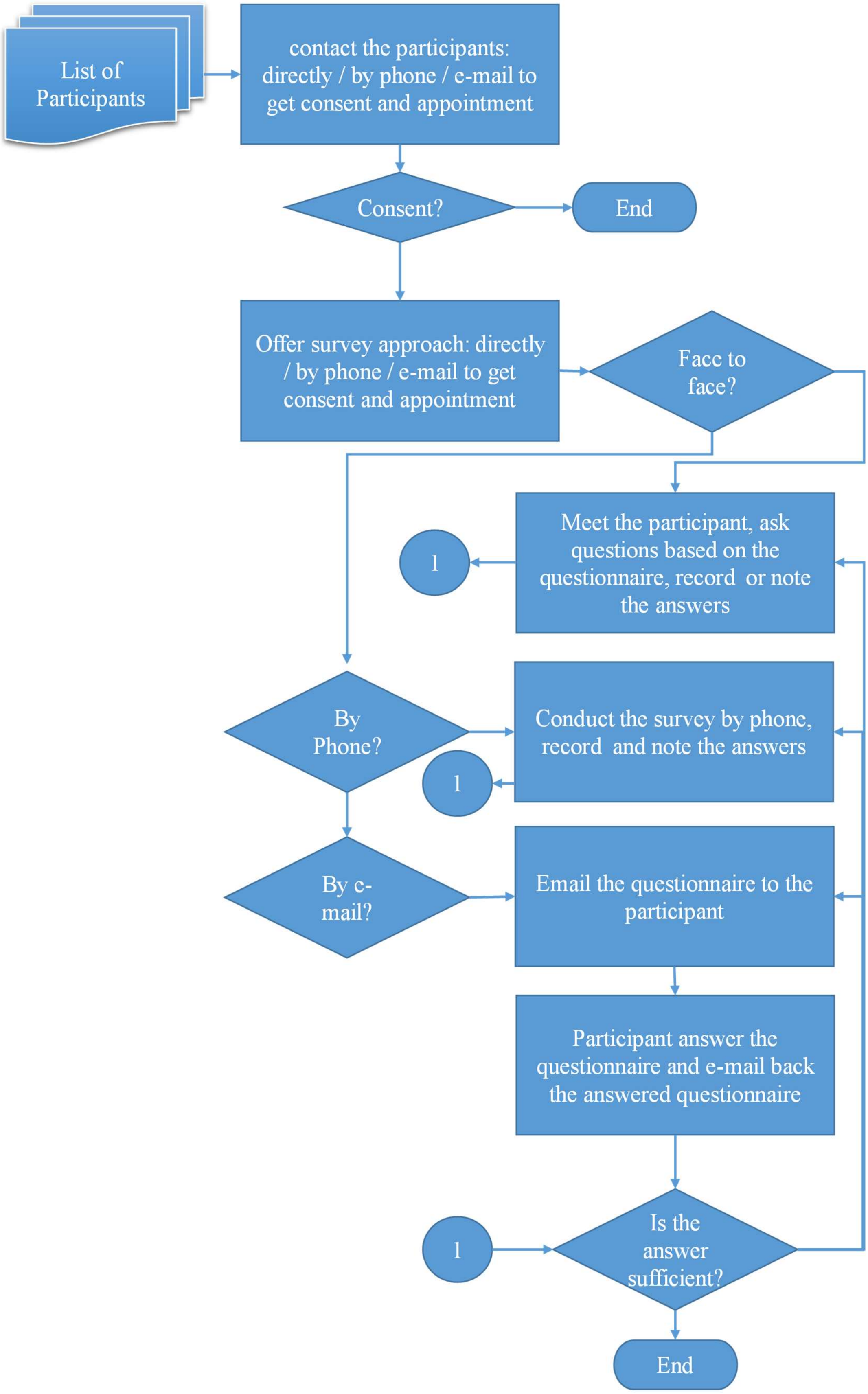


Figure 6-1: Survey Procedure

Note: maximum questionnaire loop is 3 times

The most critical challenges of this survey were the length of the questionnaire (26 pages) and the amount of detailed data needed for the answers. The detailed data included historical financial and human resource data from 1998 to 2014 and future data from 2015 to 2020. Surveyors overcame this challenge by helping the respondents to read and fill in the questionnaires.

Panel data analysis, as explained in Section 3.3, was also applied to analyse the primary data set in order to examine the impact of ICT services on the Indonesian economy through ICT utilisation by SMEs. This data related to Q3 and the analysis is presented in Chapter 7. This primary data set was also useful for investigating the factors influencing ICT services and Cloud Computing adoption by SMEs, as addressed in Q4 and Q5. The analysis for this purpose applied a probit model and is explained in Chapter 8.

Table 6-2: Descriptive statistics of the ICT services role on SMEs variables

	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
Y	528.36	213.98	15,000.00	0.05	1,029.13	2823
K	413.82	101.61	4,367.47	0.00	791.44	2823
L	14,343.75	8,736.00	1,747,200.00	0.00	52,847.94	2823
$KICT$	95.11	28.28	7,325.00	0.00	407.67	2823
$KICTS$	14.45	7.50	250.00	0.00	21.96	2823
fix	1.66	0.00	35.00	0.00	4.71	2823
mb	6.14	2.05	250.00	0.00	11.59	2823
int	2.60	0.75	105.00	0.00	8.99	2823
cc	1.78	0.00	52.50	0.00	5.26	2823

Note: all data are in million IDR, except labour capital is in hour. Source: the field survey (March to November 2015)

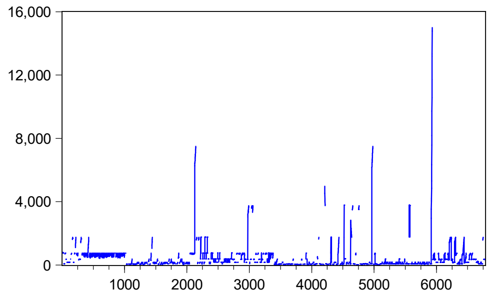
6.4 Primary Dataset for The ICT Services Role on SMEs

The primary data was collected from a panel dataset of 399 SMEs, for the period 1998 to 2014. The data was used to answer Q3, through the investigation of the ICT services influence on SMEs. The data covered the following variables: SME output (Y), the SME total capital (K), the SME labour capital (L), the SME in-house ICT capital ($KICT$), and the SME ICT services capital ($KICTS$). In addition, the panel dataset also provided the ICT services component variables that include fixed-telephone (Fix), mobile telephone (Mb), Internet (Int), and cloud computing (Cc). Details of these variables are explained in Section 6.4.

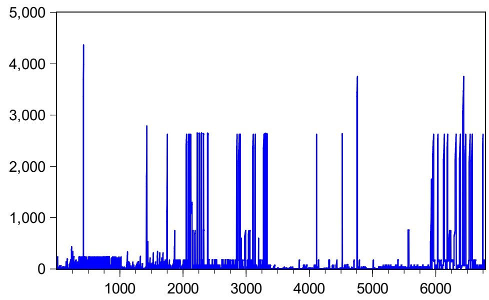
Table 6-2 presents the descriptive statistics of the variables. The mean of total capital is about 78% of the output. It can be said that the SMEs are highly spending, compared with the Indonesian SMEs profile where the mean of the total capital is only 32.93% of the output mean (see Chapter 3, Section 4.3). However, the in-house ICT and ICT services capital is quite low. The mean of the in-house ICT capital accounts for only 22.98% of the mean of the total capital. Meanwhile, the mean of the ICT services capital is only 3.49% of the mean of the total capital. Nonetheless, this figure is in line with the Indonesian profile (not only for SMEs). The mean of the Indonesian ICT services capital is only 0.68% of the total capital mean (see Section 3.4.2). In terms of the labour capital, the profile is similar to the national SME profile. The output per labour hour from this primary data is 3.68%, while the national SME profile is 3.07% (see Section 3.4.2).

Mobile telephones comprise the largest share of the ICT services capital, followed by the Internet, then by Cloud Computing, and fixed-line telephone is the least. Compared to the mean of the ICT services capital, mobile telephones accounted for 42.47 %. Meanwhile, the Internet, Cloud Computing and fixed telephone are 18.02%, 12.33%, and 11.51%, respectively. This figure is different from the global and the Indonesian profile, where the fixed-line telephone has the biggest share.

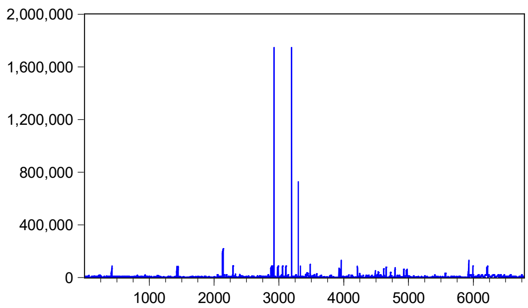
Y



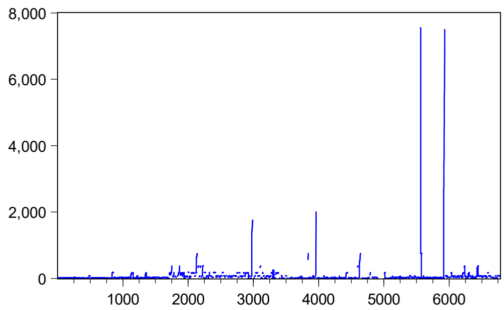
K



L



$KICT$



$KICTS$

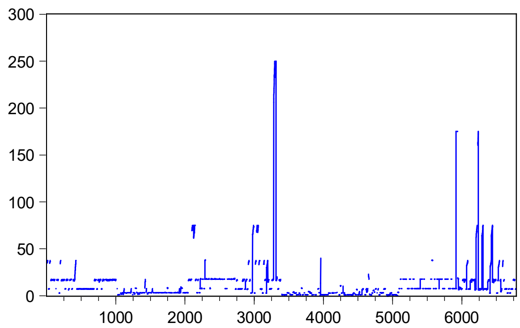


Figure 6-2: ICT Services' influence on SMEs variables

Source: the field survey (March to November2015)

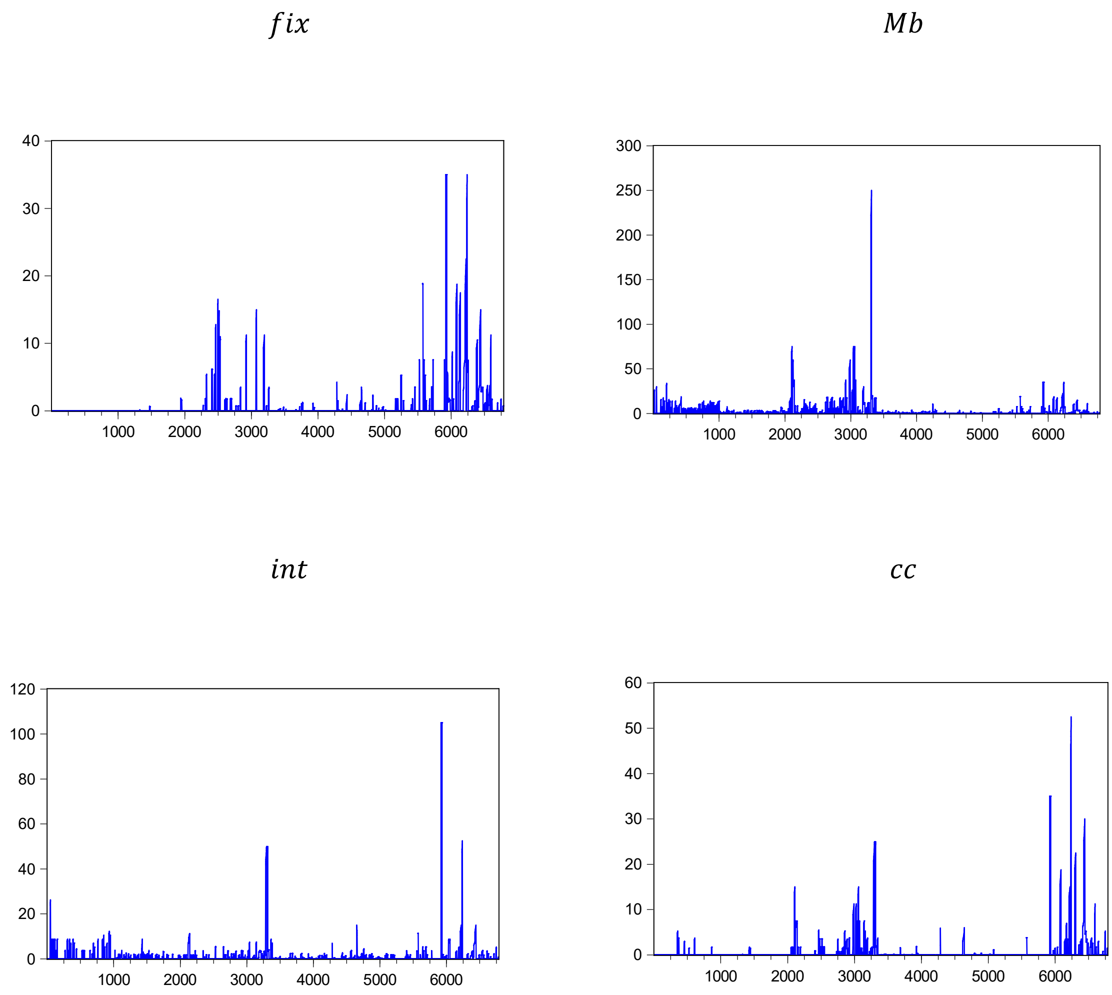


Figure 6-3: ICT Services component: fix, mb, int and cc

Source: the field survey (March to November 2015)

6.5 Primary Dataset for ICT Services Adoption

Primary data provides a binary dataset enabling examination of the significant factors influencing ICT services, specifically Cloud Computing, adoption by SMEs. The aim of the analyses is to address Q4 and Q5. The primary data covers the variables including the five group factors: management, employees, industry, innovation, and other ICT services (see Chapter 8).

6.5.1 Management Factors

The management factors include gender, management age, and management education . 73% of the survey respondents are owners or CEOs of their firms and the rest are CIO, CFO, managers or supervisors in the SMEs. Therefore, management is generally representative of the respondents in this study. The male respondents make up 63% of the total respondents of the survey. Figure 6-4 depicts the management gender profile.

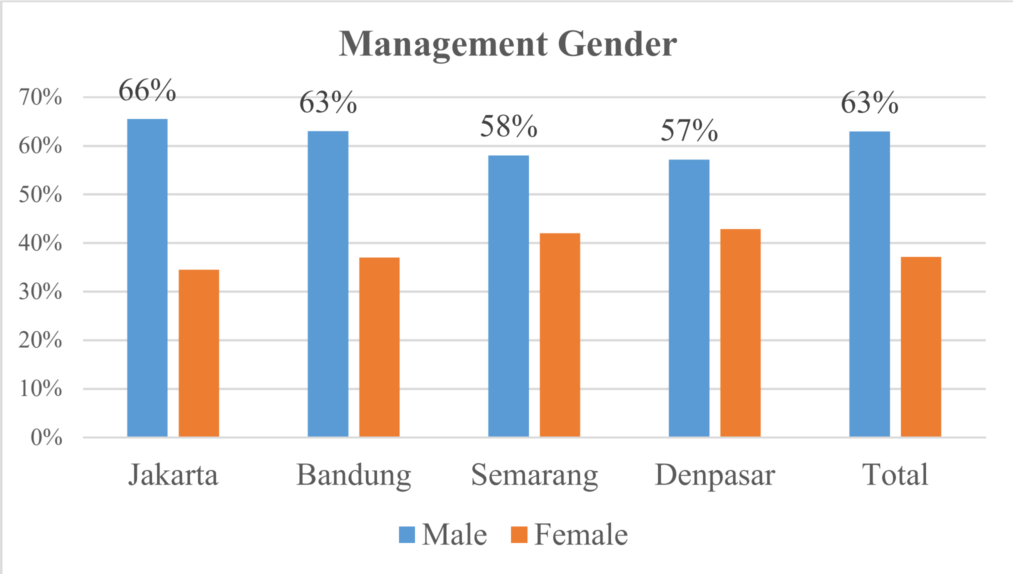


Figure 6-4: Management gender

Source: the field survey (March to November 2015)

In terms of management education, the composition includes 64% have a high school education, 20% have less than high school and 16% are university graduates. This education background is one of the factors challenging the implementation of ICT services in Indonesia's SMEs, as some of the SMEs entrepreneurs are illiterate and lack digital knowledge otherwise known as the 'digital divide'.

Meanwhile, the management age profiles from the highest to the lowest include 44% were aged between 31-40 years, 24% were between 18-30, 23% were 41-50 years and 9% were over 50 years old.

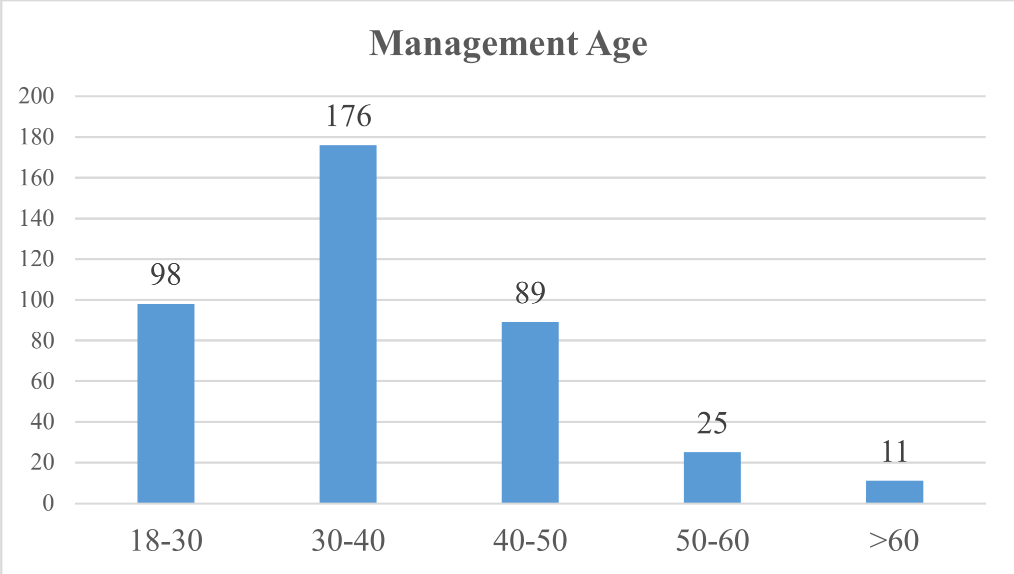


Figure 6-5: Management age

Source: the field survey (March to November 2015)

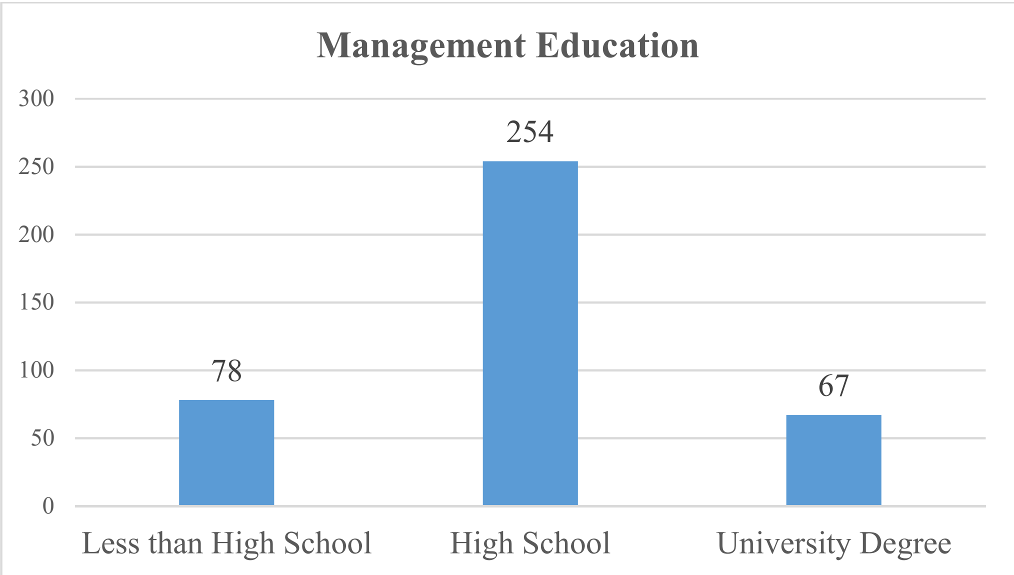


Figure 6-6: Management education

Source: the field survey (March to November 2015)

6.5.2 Employee Factors

The employee group factors indicated the ease of use and organisation aspects. These covered employee age, employee education, and employee ICT literacy level. The average number of employees was 4 persons per SME, and 42% of the SMEs employed only 1 employee. 56% of the employees were young, aged between 18 and 30. 35% were middle aged, between 30 to 40 years old. The rest were over 40.

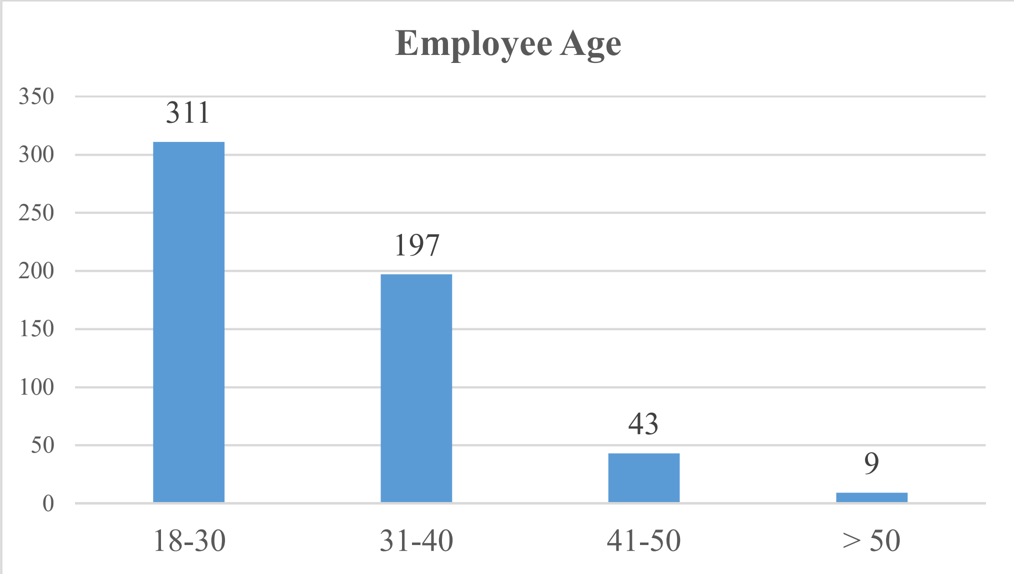


Figure 6-7: Employee Age

Source: the field survey (March to November 2015)

The employee education profile is similar to that of the management with most being high school graduates (63%), 16% had less than a high school education, and only 11% were university graduates.

The ICT literacy classifies the level of ICT skill according to three levels. Low level ICT skill means that the employees are able to use only basic ICT services, such as using fix-line and mobile telephone services (voice; text and messaging services such as Blackberry massaging, WhatsApp), social media services (Instagram, Facebook, Twitter, etc), web browsing, and email. Employees who are able to operate computers with a minimum ability to use basic Microsoft Office are categorised as having medium ICT skill. Employees who have a high level of ICT skill are able to use language programming, IT networking, etc. The primary data revealed that 68% of the employees had a medium level of ICT skill, 27% had a low level, and only 5% had high-level ICT skill.

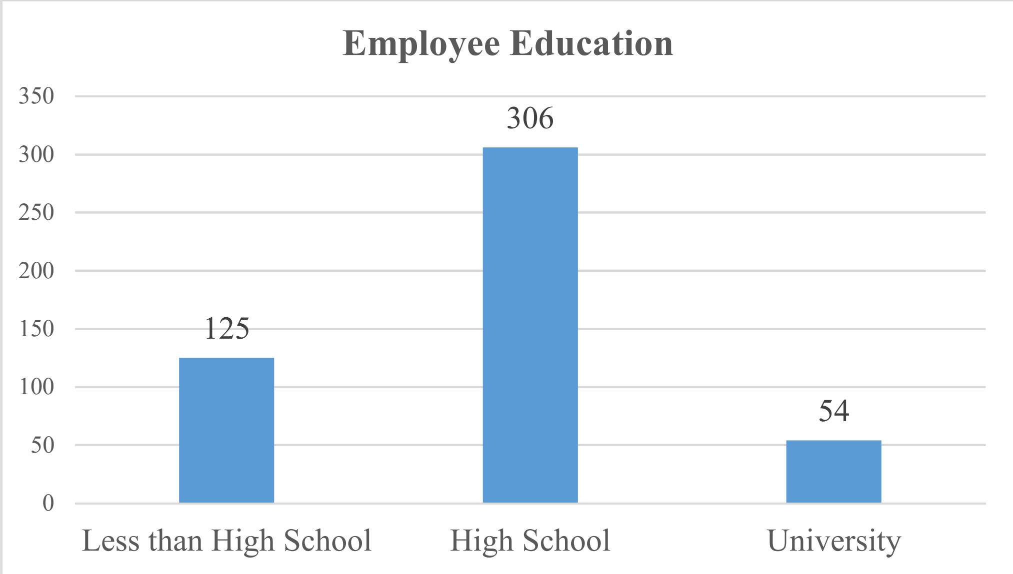


Figure 6-8: Employee Education

Source: the field survey (March to November 2015)

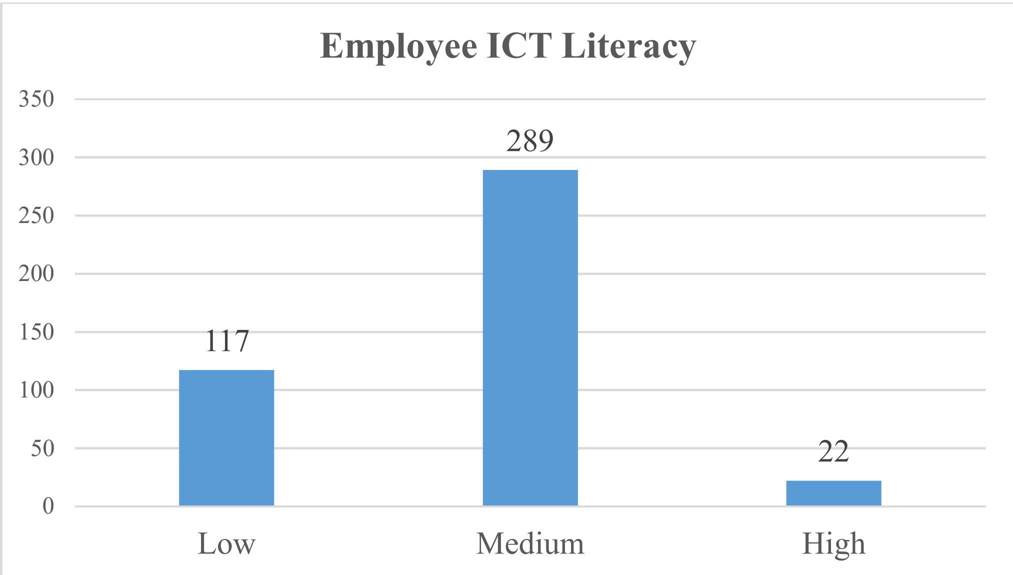


Figure 6-9: Employee ICT literacy

Source: the field survey (March to November 2015)

6.5.3 Industry Factors

Industry factors explain the attitude toward ICT services, environment and organisation (see Section 8.2). This group of factors covers the business types (bt: BRT, BW, BRS, and BA), years in business or business maturity, business scale (micro, small or medium), and the firm's location or city (Jakarta, Bandung, Semarang, and Denpasar).

45% of the SMEs are engaged in a wholesale business (BW), while 30% are reselling other business product (BRS), 23% are conducting a retail business (BRT), and about 1% are engaged in assembling products (BA).

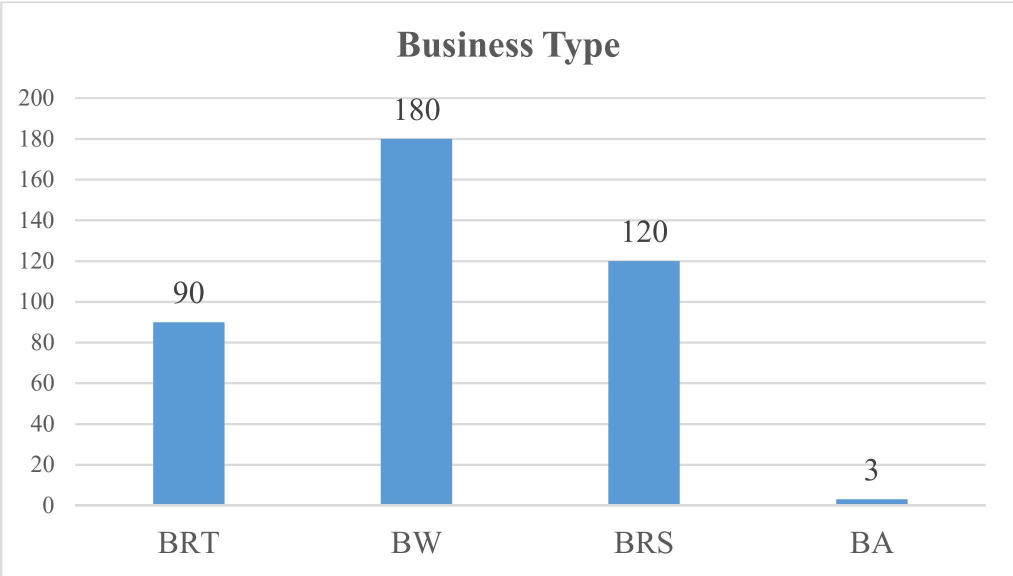


Figure 6-10: Business Type

Source: the field survey (March to November 2015)

In addition, most of the surveyed SMEs were from ICT-using industries that comprise agriculture (1%), manufacturing (4%), trading and hospitality (88%), transport and communication (2%) and other services (5%). This composition is slightly different from the overall Indonesian SME population, because the survey was conducted in two big cities, (Jakarta and Bandung) and two medium cities (Semarang and Denpasar). This is particularly true in the case of agriculture in Indonesia which contributes around 14% to economic activity (GDP) but is carried out on a relatively smaller scale in the four cities.

Table 6-3 shows the Indonesian SME population distribution compared to the data from survey respondents. This unique profile may result in different findings from those of previous studies.

The number of ICT manufacturing SMEs in Indonesia is very small and comes under the 'other services' sector, and most of them are start-up firms. The trading, hotel and restaurant sectors comprise the greatest number of Indonesian SMEs, after agriculture. Most of the agriculture is in medium to small cities; however, this field survey was conducted in cities with a medium to high growth economy.

Table 6-3: Indonesia SME population vs survey respondents

Sector	Indonesia SME Population[a]	Survey Respondents (Jakarta, Bandung, Semarang, Denpasar)
Agriculture	52%	1%
Mining	1%	0%
Manufacturing	6%	4%
Electricity & Utilities	0%	0%
Construction	1%	0%
Trading, Hotel and Restaurant	28%	88%
Transportation & communication	6%	2%
Financial and leasing	2%	0%
Other services	4%	5%

[a]*Average 2006-2009 [BPS, 2013]*

Only 50 SMEs (13%) have been in the same industry for more than 10 years. 172 SMEs (43%) have been operating for 5 years or less, and 177 (44%) have been operating for 6 to 10 years.

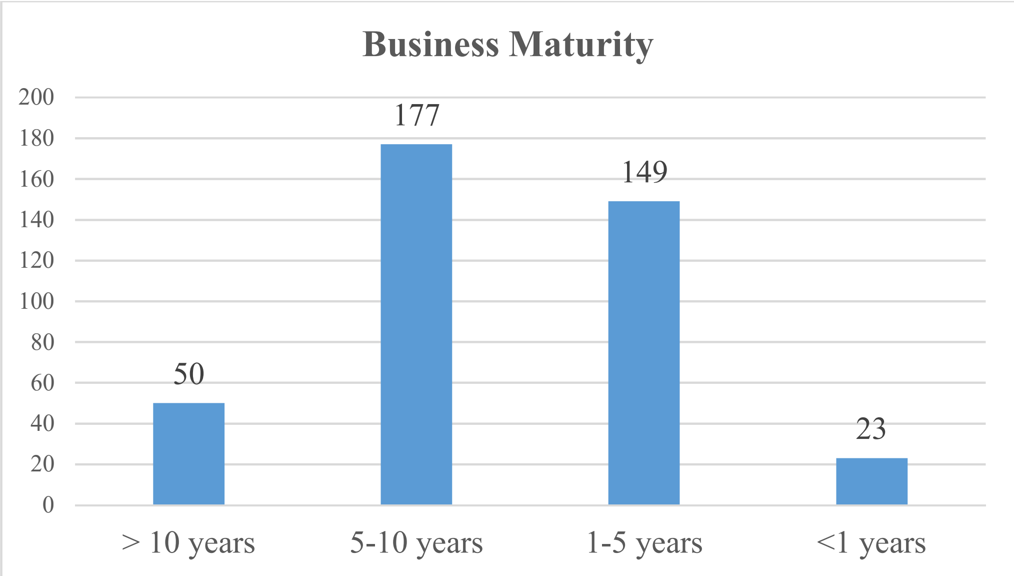


Figure 6-11: Business Maturity

Source: the field survey (March to November 2015)

The SME life cycle is not as long as that of large enterprises; after five years in business, they generally become large enterprises or cease to operate, with only a small percentage of SMEs continuing to operate in the same industry for more than 10 years. If SMEs seek to grow from the start, they will inevitably meet new challenges and crises over time that must be addressed effectively if the business is to survive and prosper, since the average life span of many SMEs is only five years (Jones, 2009).

Data from the 399 valid returned questionnaires showed that 200 SMEs (50%) are located in Jakarta, 100 SMEs (25%) are in Bandung, 50 SMEs (12.5%) are in Semarang and 49 SMEs (12.5%) are in Denpasar. In terms of business size, 65 (16%) are micro, 203 (51%) are small and 128 (32%) are medium-sized SMEs.

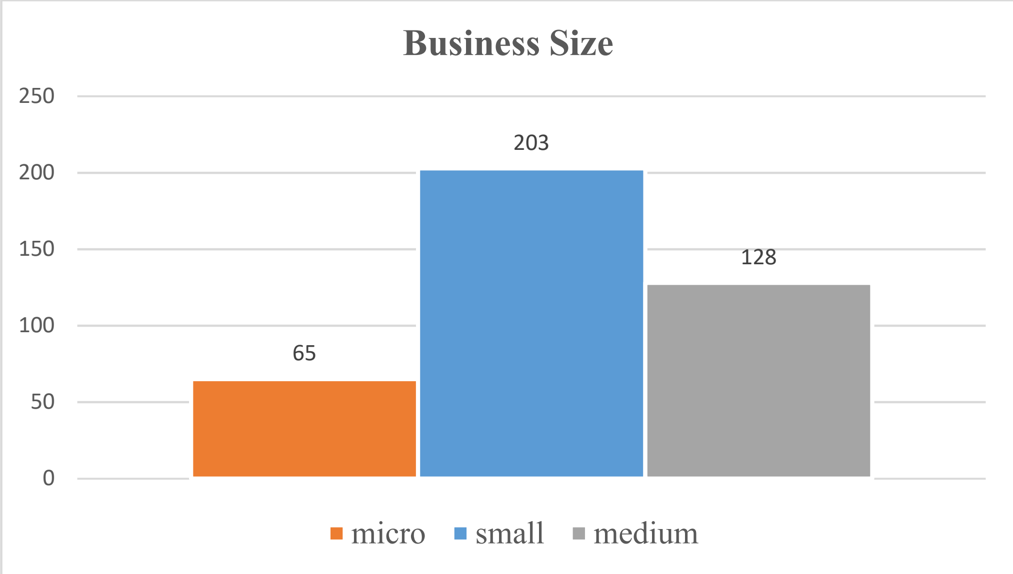


Figure 6-12: Business Size

Source: the field survey (March to November 2015)

6.5.4 Innovation Factors

Despite their low educational background, surprisingly, 90% of the respondents were aware of and knew their competitors, and indicated that improvement of products and business practices as well as R&D would enable them to gain a competitive edge. Almost all of them (98% of the valid data) regularly engaged in improvement, with 70% indicating that they undertook some improvement more than twice a year. Most of the improvements related to the product design. Only a few were related to marketing, sales, inventory and production processes. The percentage of SMEs engaged in R&D was also quite high (91%), even though most of them (84%) allocated only 1% or less of their revenue to the R&D budget. They use R&D mainly for market and competitor research.

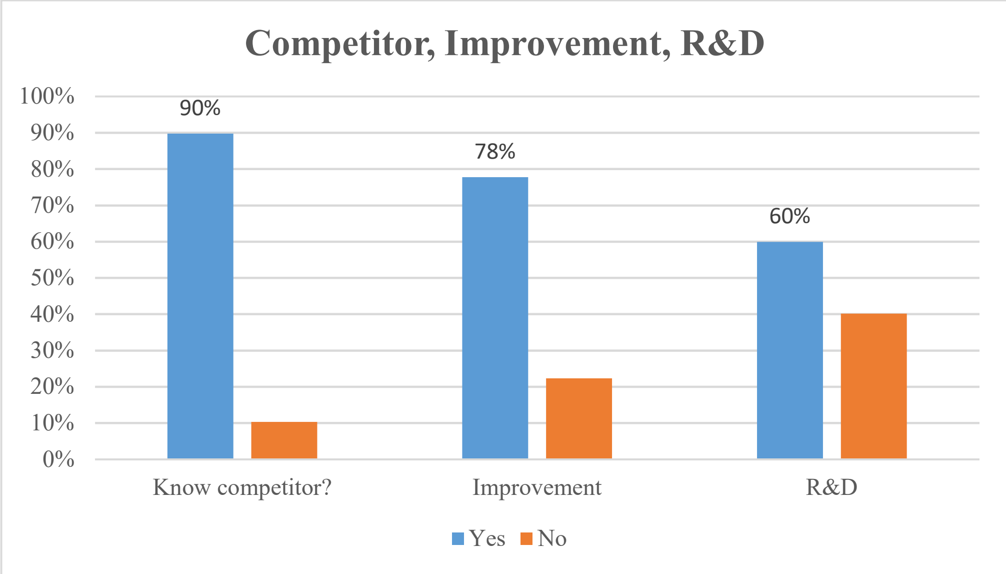
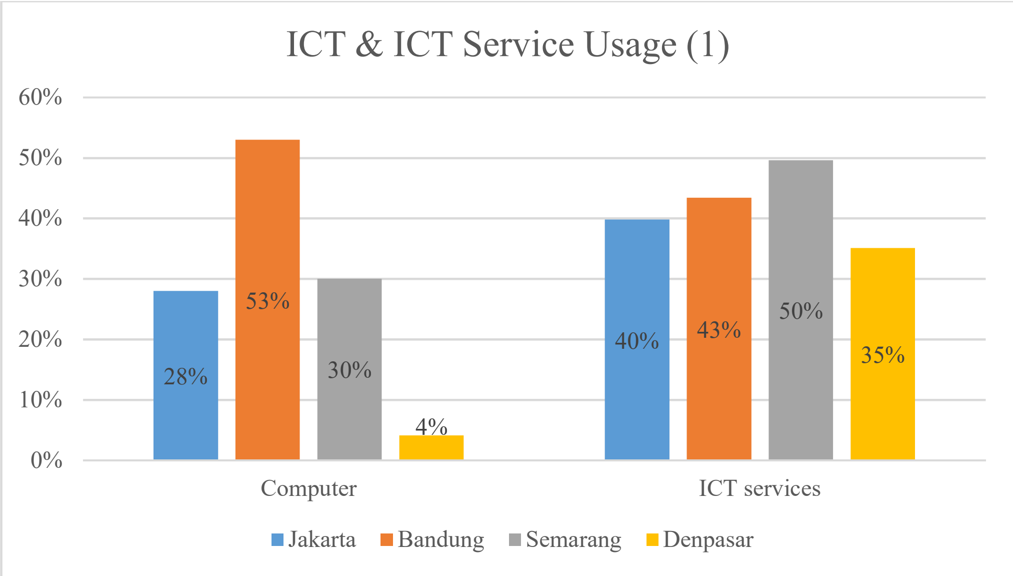


Figure 6-13: Knowledge of competitor, continuous improvement, and R&D

Source: the field survey (March to November 2015)

6.5.5 Other ICT Services Factors

The utilisation of ICT and ICT services by SMEs was only 40% and 41% respectively. In terms of usage of ICT services, SMEs were moving from fixed-line phones to mobile phones. At the time of the survey, only 26% of 399 SMEs were using fixed-line phones for their business, in contrast to 96% who were using mobile phones. Internet and Cloud Computing were becoming important tools to support SME business activities; 57% of the SMEs surveyed were using the Internet and 26% were using Cloud Computing. Figure 6-14 depicts the utilisation of ICT and ICT services by the surveyed SMEs.



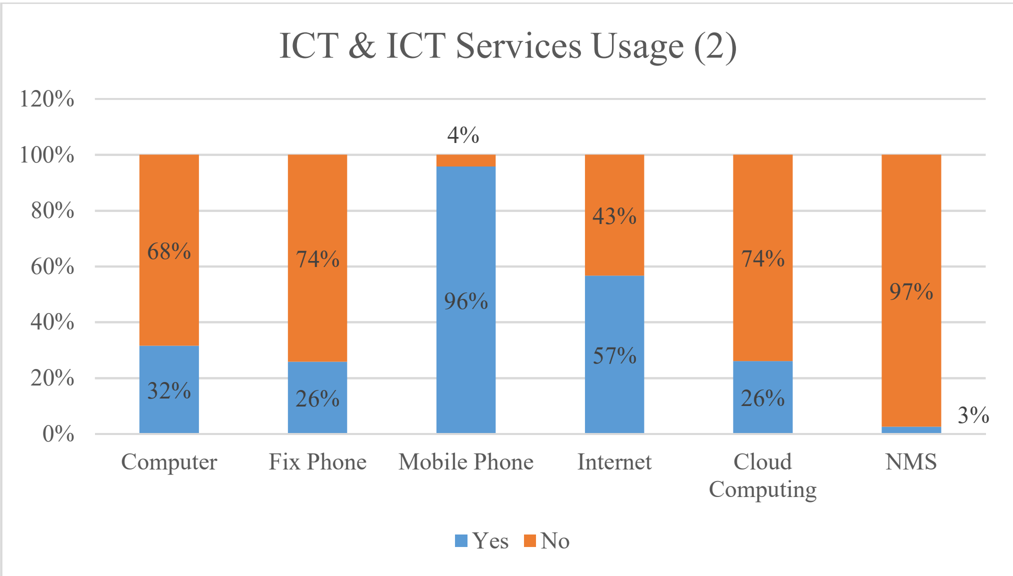


Figure 6-14: ICT and ICT services usage

Source: the field survey (March to November 2015)

Increasing sales, increasing customer service, time efficiency and increasing productivity are the top four reasons that SMEs are using ICT, followed by reducing cost as the fifth reason. For this question, more than one answer could be chosen by the participant. Those are the top four reasons why SMEs would consider using ICT to support their business. SMEs appear to be less concerned about the price, security, and appropriateness for their business, product or service, and customers.

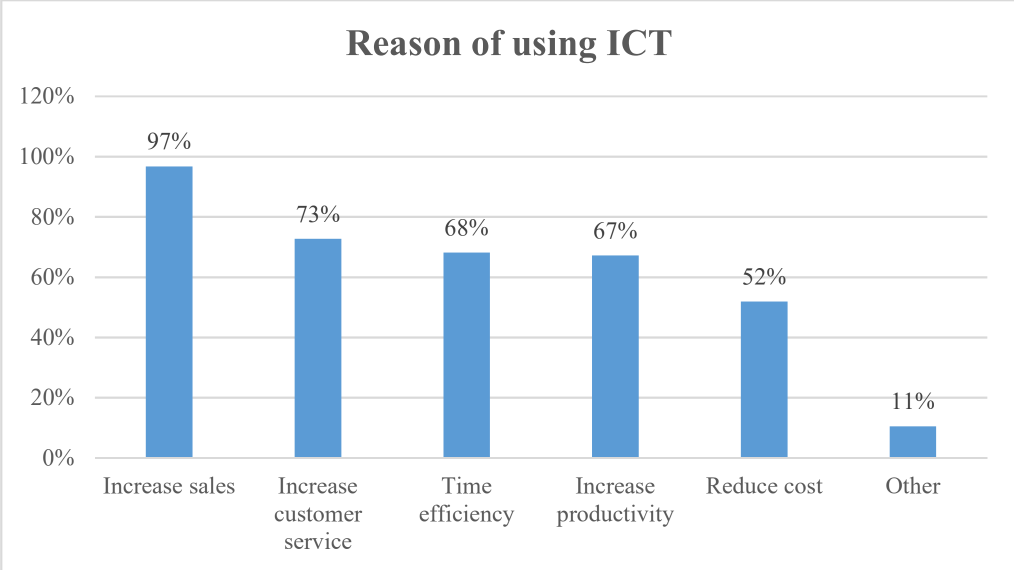


Figure 6-15: Factors triggering ICT utilisation

Source: the field survey (March to November 2015)

On the other hand, SMEs also face several challenges that hinder their ICT utilisation. These include: difficulties in the implementation of ICT, not knowing which ICT solution suits their business; the perception that ICT would make their work more complicated; and they do not have time to implement the ICT. These opinions are depicted in Figure 6-16.

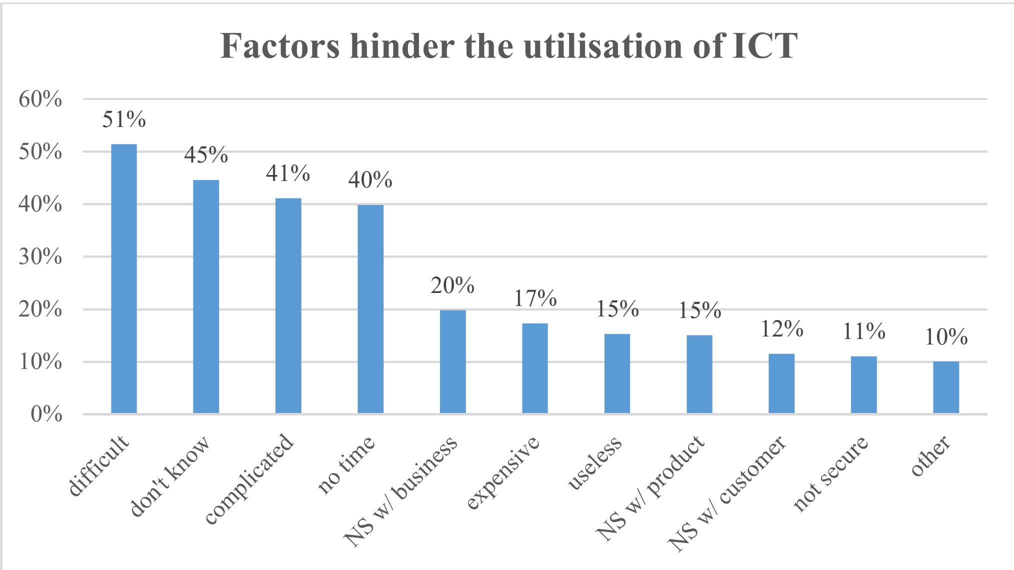


Figure 6-16: Factors hindering the utilisation of ICT

Source: the field survey (March to November 2015)

6.5.6 Cloud Computing Adoption

Of the 399 respondents, 109 (27%) knew about Cloud Computing, and 106 of them used Cloud Computing to support their business. The highest proportion of respondents that had used Cloud Computing was in Semarang (48%), followed by Bandung (27%) and Jakarta (27%); Denpasar had the lowest proportion, at only 4%.

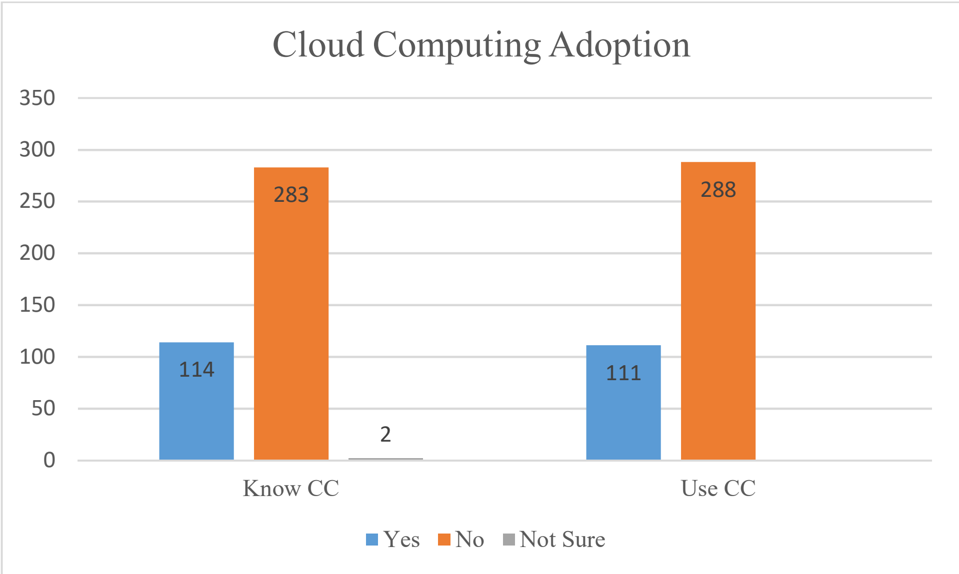


Figure 6-17: Cloud computing familiarity

Source: the field survey (March to November2015)

38% of the cloud Computing users had been using Cloud Computing for 3-5 years, 35% more recently (less than 3 years) and 27% had been using it for more than 5 years. SaaS was the most commonly used (92%), while IaaS and PaaS were used by only 5% and 3%, respectively.

Respondents believed that the top three Cloud Computing benefits were to increase sales (25%), time efficiency (22%) and to improve customer service quality (20%). Only 15% considered that Cloud Computing might reduce operating costs.

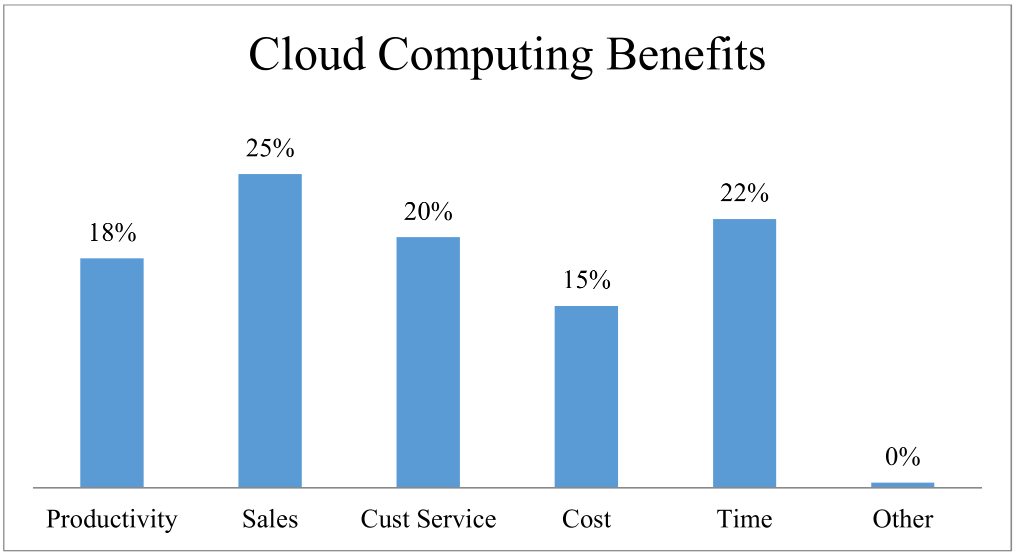


Figure 6-18: Cloud computing benefits

Source: the field survey (March to November 2015)

However, there were also several factors that hindered the adoption of Cloud Computing. SMEs found that it was too difficult to use Cloud Computing services (34%), did not have time to implement Cloud Computing (20%) and did not know which Cloud Computing services were appropriate for their business (16%). These results indicated that they did not really understand Cloud Computing. One of the advantages of Cloud Computing is that it can be operated by non-skilled employees, but many SMEs still believed that it was too difficult to implement. This may also correlate with the low education level (84% were high school graduates or lower).

Most of the respondents (48%) were willing to use Cloud Computing in the future, whereas 145 respondents would use (or would still use) it for the next 1 to 3 years, and 49 respondents for 4-5 years. The SMEs wanted to use cloud Computing to increase sales (29%), improve productivity (19%) and to improve customer service quality (18%). 19% of respondents did not want to use Cloud Computing in the future, 30% were unsure and 3% did not respond to this question. The top three reasons that the SMEs did not want to use Cloud Computing were: it was too difficult to use Cloud Computing (27%), it was too complicated to implement Cloud Computing (21%) and they would not have time to implement Cloud Computing (16%). The reasons provided possibly highlight the education needed to convince the SMEs that they could benefit by adopting Cloud Computing for their business. Issues of security, price and appropriateness were less of a concern.

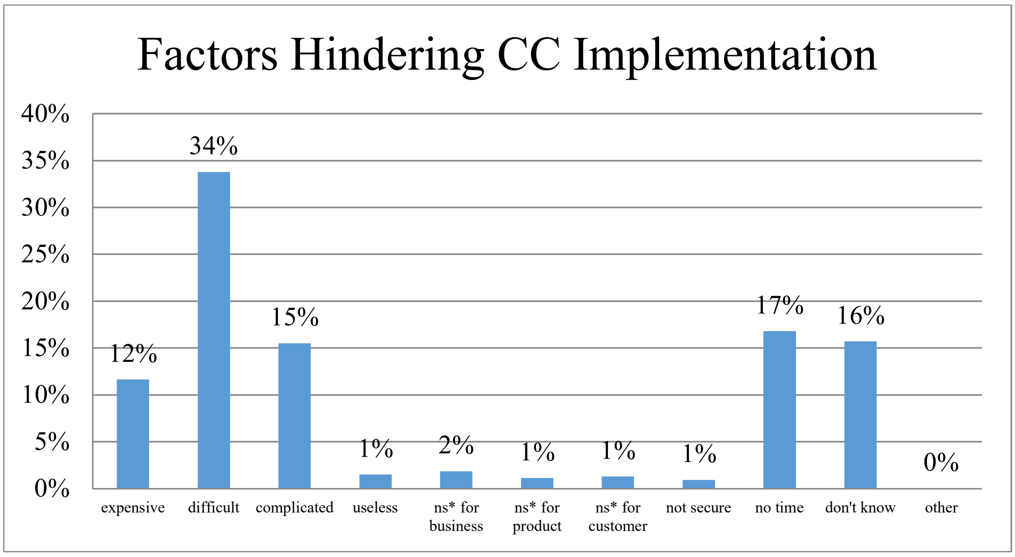


Figure 6-19: Factors hindering Cloud Computing adoption

**ns – not suitable. Source: the field survey (March to November 2015)*

6.6 Summary

For this study, a field survey was conducted to gather primary data, as a secondary data source was unavailable. The field survey was carried out from March to November 2015, in four cities in Indonesia. The primary data provide a panel dataset of 399 SMEs over the period from 1998 to 2014. The data covers the SME total capital, labour capital, ICT capital, and ICT services capital. The data was used to investigate the impact of ICT services on SMEs.

In addition, the primary data also comprised a set of binary data from the 399 SMEs. The data covers management factors (gender, age, education), employee factors (age, education and ICT literacy), industry factors (business type, business scale, business maturity, and location), innovation factors (competitor knowledge, continuous improvement, and R&D), also other ICT factors (computer, fixed-line telephone, mobile telephone, Internet, and Cloud

Computing). The data was used to analyse the factors affecting the ICT services adoption, specifically the Cloud Computing adoption, by SMEs.

Chapter 7 : The Influence of ICT Services on SMEs: The Empirical Evidence from Indonesia

7.1 Introduction

Using secondary data, it was found in Chapter 4 that the impact of ICT services on developed countries is significant. The impact of ICT services on developing economies can be seen only when it is complemented with capital. Further in Chapter 5,this study sees the implications of ICT services for the economic growth of Indonesia, where it was found that ICT services and SMEs positively contribute to the growth of Indonesia's economy.

This chapter presents empirical evidence of the impact of ICT services on Indonesian SMEs. The analysis employed here was different from that in previous chapters because primary, instead of secondary, data was used (see Chapter 6). Panel regression analysis incorporating the Cobb Douglass Production Function was applied in this analysis, as discussed in Chapter 3. In essence, the findings of this chapter complement the findings from the analysis of ICT services and SME impact on the Indonesian economy but also provide more detailed insights into the influence of ICT services on SMEs in Indonesia.

This chapter is organised as follows. The econometric models of this analysis are discussed in Section 7.2. Section 7.3 examines the contribution made by ICT services to Indonesian SMEs. Finally, the discussion of the integrated findings from this analysis and the previous findings, especially the influence of ICT services and SMEs on the Indonesian economy, is presented in Section 7.4.

7.2 Econometric Models

The primary data for this analysis was derived from Sections B, C, E, and F of the field survey questionnaire (explained in Section 6.2). The models were developed using the Cobb Douglass Production Function approach and panel estimation. This empirical model and the econometric techniques used here are similar to those applied to the secondary data analysis, and explained in Section 3.3.

7.2.1 The variables

To analyse the role of ICT services in SMEs, the following variables were generated. The dependent variable (Y) is the SMEs annual revenue. The independent variables considered are: total capital (K), labour capital (L), ICT capital ($KICT$), and ICT services capital ($KICTS$). The ICT services capital is the firm's annual spending on ICT Services, which includes fixed-line telephone, mobile telephone, Internet, Cloud Computing and other ICT services (such as managed services).

Table 7-1: Variable definition for ICTS role on SMEs

Variable	Definition	Source
$\boldsymbol{Y}$	SMEs output = annual Revenue (in million IDR)	Field Survey
$\boldsymbol{K}$	SMEs annual total capital = total investment + total expenses – (ICT expenses and ICTS expenses) (in million IDR)	Field Survey
$\boldsymbol{L}$	SMEs annual Labour capital = number of employees * average labour hours worked (in hours worked)	Field Survey
$\boldsymbol{KICT}$	SMEs in-house ICT capital is the firm's annual spending on in-house ICT (in million IDR)	Field Survey
$\boldsymbol{KICTS}$	SMEs total ICT Services capital is the firm's annual spending on ICT Services that includes: fixed-line telephone, mobile telephone, Internet, cloud computing and other ICT services (such as managed services) (in million IDR)	Field Survey
$\boldsymbol{Fix}$	SMEs Fixed-line telephone Services capital is the firm's annual spending on fixed-line telephone services (in million IDR)	Field Survey
$\boldsymbol{Mb}$	SMEs Mobile Telephone Services capital is the firm's annual spending on mobile telephone services (in million IDR)	Field Survey
$\boldsymbol{Int}$	SMEs Internet Services capital is the firm's annual spending on Internet services (in million IDR)	Field Survey
$\boldsymbol{Cc}$	SMEs Cloud Computing Services capital is the firm's annual spending on cloud computing services (in million IDR)	Field Survey

ICT capital is the business expenditure on in-house ICT (excluding ICT services). ICT and ICTS were excluded from the total capital that covers other ICT and ICTS investment and expenses. Labour capital (L) was calculated from the average number of employees multiplied by the average yearly working hours. All variables, except L, are in million IDR, while L is in hours.

7.2.2 The estimation models

This analysis applied a Cobb-Douglass Production Function framework and panel regression analysis, similar to the method used for the cross-country analysis, see Section 3.3. Considering the variables described in Section 7.2.1, the basic model for this study is:

$$Y_{it} = \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 KICT_{it} + \beta_4 KICTS_{it} + \varepsilon_{it} \tag{7-1}$$

Where Y_{it} is the SME output represented by SME annual revenue, K_{it} is SME non-ICT capital, L_{it} is the labour capital, $KICT_{it}$ is SME in-house ICT capital, and $KICTS_{it}$ is SME ICT services capital.

Next, to investigate how ICT services collaborate with other variables, a model was generated based on (3-8):

$$Y_{it} = \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 K_{it} * KICTS_{it} + \beta_4 L_{it} * KICTS_{it} + \varepsilon_{it} \tag{7-2}$$

This study also investigated the impact of the previous 1 to 4 years of ICT services capital on the current year's SME output. Therefore, based on (3-10) the following model was generated:

$$\begin{aligned} Y_{it} = C + \beta_1 \sum_0^4 K_{it} + \beta_2 \sum_0^4 L_{it} + \beta_3 \sum_0^4 KICT_{it} + \beta_4 \sum_0^4 KICTS_{it} \\ + \beta_5 \sum_1^4 Y_{it} + \varepsilon_{it} \end{aligned} \tag{7-3}$$

This lag model was also applied to examine the complementary role of ICT services with other capital from preceeding years, by combining equations (7-2) and (7-3):

$$Y_{it} = C + \beta_1 \sum_0^4 K_{it} + \beta_2 \sum_0^4 L_{it} + \beta_3 \sum_0^4 KICT_{it} + \beta_4 \sum_0^4 KICTS_{it} + \beta_5 \sum_0^4 K_{it} * KICTS_{it} + \beta_6 \sum_0^4 L_{it} * KICTS_{it} + \beta_7 \sum_0^4 KICT_{it} * KICTS_{it} + \beta_8 \sum_1^4 Y_{it} + \varepsilon_{it} \quad (7\text{-}4)$$

Further, this study also investigated the role of ICT service components that cover fixed-line telephones (Fix), mobile telephones (Mb), Internet (Int) and Cloud Computing (CC), and also the complementary effects amongs those ICT services components. The models used refer to equations (7-1) to (7-4), by replacing $KICTS$ with Fix, Mb, Int and CC.

The basic model for the ICT services component is as follows:

$$Y_{it} = C + \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 KICT_{it} + \beta_4 Fix_{it} + \beta_5 Mb_{it} + \beta_6 Int_{it} + \beta_7 CC_{it} + \varepsilon_{it} \quad (7\text{-}5)$$

Furthermore, the complementary model of the ICT services component is:

$$Y_{it} = C + \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 KICT_{it} + \beta_4 KICTS_{it} + \beta_5 Fix_{it} * Mb_{it} + \beta_6 Fix_{it} * Int_{it} + \beta_7 Fix_{it} * CC_{it} + \beta_8 Mb_{it} * Int_{it} + \beta_9 Mb_{it} * CC_{it} + \beta_{10} Int_{it} * CC_{it} + \varepsilon_{it} \quad (7\text{-}6)$$

Next, the following model examines the lag (0 to 4) effect of ICT services components:

$$Y_{it} = C + \beta_1 \sum_0^4 K_{it} + \beta_2 \sum_0^4 L_{it} + \beta_3 \sum_0^4 KICT_{it} + \beta_4 \sum_1^4 Y_{it} + \beta_5 \sum_0^4 Fix_{it} + \beta_5 \sum_0^4 Mb_{it} + \beta_6 \sum_0^4 Int_{it} + \beta_7 \sum_0^4 CC_{it} + \beta_8 \sum_1^4 Y_{it} + \varepsilon_{it} \quad (7\text{-}7)$$

7.3 Results and Analysis of ICT Services Impact on SMEs

7.3.1 Unit Root Test

The unit root test result is reported in Table 7-2. The main variables, except labour capital, are stationary, while the ICT service component variables are non-stationary except mobile telephone capital. In terms of the complementary variable, the complementary variable between ICT services capital and total capital, also between ICT services capital and labour capital are stationary. The complementary effects between ICT services components are non-stationary, except the complementary effect between fixed-line telephone and Internet.

Table 7-2: Unit Root Test Result

Variable	LLC	Breitung	IPS	ADF	PP	S /NS[a]
$\boldsymbol{Y}$	0.0000	0.5000	0.0000	0.0000	0.0000	S
$\boldsymbol{K}$	0.0000	0.5000	0.0000	0.0000	0.0000	S
$\boldsymbol{L}$	0.0000	0.5000	0.4722	0.8782	0.0010	NS
$\boldsymbol{KICT}$	0.0000	0.5000	0.0000	0.0000	0.0000	S
$\boldsymbol{KICTS}$	1.0000	0.5000	0.0139	0.0000	0.0000	S
$\boldsymbol{Fix}$	1.0000	0.5000	0.8688	0.3571	0.0000	NS
$\boldsymbol{Mb}$	0.8090	0.5000	0.0000	0.0117	0.0000	S
$\boldsymbol{Int}$	1.0000	0.5000	0.1158	0.0003	0.0000	NS
$\boldsymbol{CC}$	1.0000	0.5000	0.3382	0.0106	0.0000	NS
$\boldsymbol{K * KICTS}$	0.0000	0.5000	0.0000	0.0000	0.0000	S
$\boldsymbol{LH * KICTS}$	0.0000	0.5000	0.0000	0.0000	0.0000	S
$\boldsymbol{Fix * Mb}$	1.0000	0.5000	0.7030	0.2404	0.0000	NS
$\boldsymbol{Fix * Int}$	0.0000	0.7423	0.0003	0.0000	0.0000	S
$\boldsymbol{Fix * CC}$	0.0000	0.7100	0.7594	0.3120	0.0056	NS
$\boldsymbol{Mb * Int}$	1.0000	0.5000	0.6020	0.0439	0.0000	NS
$\boldsymbol{Mb * CC}$	1.0000	0.5000	0.3924	0.0183	0.0000	NS
$\boldsymbol{Int * CC}$	0.1203	0.2868	0.9974	0.9999	0.9999	NS

Note: This table reports the p-values for the unit root test. The null hypotheses of unit root apply for all the tests LLC and IPS refer to Levin, Lin & Chu and Im, Pesharan and Shin respectively. All the variables are expressed in logarithmic form. LLC and Breitung assume common unit root, while the rest assume an individual unit root process. Individual effects and individual linear trends are applied in all tests. [a] NS-Non Stationary, S: Stationary.

7.3.2 Estimation Result

The results depicting the effect of ICT services on SMEs output captured by Model 7-1 to Model 7-5 are presented in Table 7-3. ICT services are significant and have a positive impact on the basic Model 7-1. However, if lag variables, from lag -1 to lag -3, are accounted for, ICT services are still significant although the impact is negative: Model 7-2 to Model 7-4. For lag -4 model (Model 7-5), ICT services are not significant. The lag -1 of ICT services shows a strong positive association with the output in Model 7-2, but ICT services become insignificant when the next lag variables, lag -2 to lag -4 are considered. There are positive correlations between ICT services lag -2 with the output in lag -2 and lag -4 models (Model 7-3 and Model 7-5). The ICT services lag -4 is also found to positively contribute to the output, (Model 7-5). In contrast, the ICT services lag -3 is significant but negatively affects the output. Overall, the ICT service capital directly contributes to increasing the output in the first year of the implementation, but after several years of the implementation, the current ICT services value does not provide significant impact or will impact negatively. However, if the business has implemented the ICT services for two or four years, then the firm will still benefit from the last two or four years of ICT service.

In terms of the in-house ICT, it is found to be significant by itself. However, if lag variables were involved, then the current in-house ICT is insignificant. The lag models show evidence that lag in-house ICT capital is insignificant.

Further to the analysis, the complementary effect between ICT services and other capital is explained in Table 7-4 (Model 7-6 to Model 7-145). The basic model found that ICT services work in a complementary way either with capital or labour, to support the output growth (Model 7-6 and Model 7-101). Similar results are also found in Model 7-12Model 7-145). The role of lag -1 to lag -4 ICT services complemented either with capital or labour are significant and positive to the output, when only the lag variables are accounted for. However, if all variables are considered (Model 7-67 to Model 7-10), the results show that current ICT services work in a complementary way only with capital, but not with labour. For the lag effect, only labour-augmented ICT services lag -2 is significant and positive (Model 7-8), while capital-augmented ICT services lag -1 (Model 7-67) and lag -2 (Model 7-8) are significant but have a negative impact.

It can be argued that the current ICT services effectively support the output in the first year of the implementation. However, for businesses that have implemented ICT services for more than a year, the benefit of their current ICT services will be gained through the collaboration either with other capital or with labour.

Focusing on the impact of ICT services, Table 7-5 provides the ICT services components that cover fixed-line telephone, mobile telephone, Internet and Cloud Computing (Model 7-16 to Model 7-20). Referring to the previous finding from Model 7-1) where the contribution of ICT services is significantly positive, the basic model in Table 7-5 (Model 7-16), shows that the significant contributors to the ICT services impact are the fixed-line telephone and mobile telephone. However, if the other lag variables are considered, then none of the ICT services component variables are positively significant (Model 7-17Model 7-20). These findings confirm the previous findings for (Model 7-2Model 7-5) where ICT services are also insignificant if other lag variables are considered. Lag -1 fixed telephone is found to be significant and positive in the lag -2 (Model 7-18) and lag -4 (Model 7-20). This result seems to be not in line with the previous finding, where ICT services lag -1 is significant and positive only in the lag -1 model (Model 7-2). However, these results indicate that the lag -1 ICT services impact is contributed to by all components together; in other words, there is no dominant contributor. The next variable that contributes in a significantly positive way is mobile telephone at lag -3 (Model 7-19).

The next results in Table 7-6 reveal the collaboration among ICT services components, in Model 7-21 to Model 7-25). What is interesting from the results in this table is that the fixed-line telephone collaborates with the Internet in the current year (Model 7-21), lag -1 (Model 7-22 and Model 7-23). This result indicates that SMEs that are using a landline Internet might be more productive than others. Some variables show significant but negative results. However, such results were only appears occasionally. Therefore, these results were not discussed further.

7.4 Key Findings

The estimation results, explained in the previous section, indicate five key findings of the ICT services impact on Indonesian SMEs. This section links those five findings with the previous findings, from the global trend analysis (Chapter 4) and from the Indonesian context (Chapter 5).

First, ICT services have a significant and positive influence on increasing the SME output. This finding is similar to the situation in the group of developed countries. Moreover, it also supports previous findings that ICT services significantly contribute to Indonesia's economic growth. This result supports those of previous studies that found ICT services provide benefits for SMEs (Colombo et al., 2013; Roos and Blumenstein, 2015).

Second, ICT services also help to increase the SME output through collaboration with the total capital. This result confirms the association between total capital-augmenting ICT services and the output; this was also found in the global trend, both in developed and developing nations. Furthermore, the Indonesian finding was consistent with this. The significant impact of the collaboration between in-house ICT and total capital on output was also found in previous studies (Samoilenko and Osei-Bryson, 2008).

Third, this study also found that labour-augmented ICT services significantly and positively increased SME revenue. Unlike the earlier findings, however, this collaboration is not found either in the Indonesian context or in the global trend. Thus, this collaboration was found only for the first year of the ICT implementation by the SMEs. There is no significant collaboration effect between ICT services capital and labour capital on the SME output for a business that has been implementing ICT for more than one year. This finding is in accord with that of Samoilenko and Osei-Bryson (2008), indicating that in-house ICT capital works with labour to improve output.

Fourth, the previous years' ICT services (lag -2 and lag -4) influence SME output for the current year. Nonetheless, SMEs that have been implementing ICT services for more than one year derive more benefits from the previous ICT services capital than the current ICT services.

Fifth, fixed-line telephones and mobile telephones significantly contribute to the impact of ICT services capital on SMEs that is revealed in the first finding. Additionally, the collaboration between the fixed-line telephone and the Internet contribute significantly to increasing SME output. This finding indicates that landline Internet provides more benefit to SMEs, than does the mobile Internet.

Previous analysis examining the role of SMEs in Indonesia's economy, in Chapter 5, suggests that SMEs significantly contribute to Indonesia's economy through labour and total capital augmenting labour. The analysis in this chapter indicates that ICT services contribute significantly to increasing the SME output, either by itself or through the collaboration with total capital and labour. Taken together, these findings suggest that ICT services contribute to Indonesia's economic growth, through their utilisation by SMEs. ICT services help to increase SMEs output that eventually contributes to the growth of the Indonesian economy.

7.5 Summary

This section investigated the most critical problem in this study. The problems studied in this chapter relate to Q3. Moreover, the study was intended to examine the role of ICT services in SME output. An analysis of primary data was conducted, incorporating the Cobb Douglass Production Function and the panel estimation method.

The findings reveal that ICT services directly contribute to increasing output in the first year of the implementation, with fixed-line and mobile telephones as the main contributors. For the firm that has implemented the ICT services for more than one year, the benefit of the ICT services is derived from the previous two or four years ICT service. In addition, they also benefit from current ICT services through the collaboration either with other capital or with labour. The findings also indicate that SMEs that are using landline Internet might be more productive than others.

Linking with the findings from the previous analysis, it could be argued that there is evidence that ICT services, used by SMEs, play a role in Indonesia's economy.

To better understand the factors affecting ICT services adoption, specifically the adoption of Cloud Computing, the next chapter (Chapter 8) further examines the significant factors influencing the implementation of ICT services by SMEs. The analysis in Chapter 8 addresses Q4 and Q5.

Table 7-3: The role of ICT Services on SMEs: Basic and lags models

This table reports coefficient and probability estimates and the model's adjusted R-squared for Model 7-1 to Model 7-5. Model 7-1 is the basic model, while Model 7-2 to Model 7-5 are the lag-1 to lag-4 models. The models are: $Y_{it} = C + \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 KICT_{it} + \beta_4 KICTS_{it} + \varepsilon_{it}$ (Model 7-1); $Y_{it} = \mathrm{C} + \beta_1 \sum_{\mathrm{n}}^{1} Y_{it} + \beta_2 \sum_{\mathrm{n}}^{0} K_{it}\, \beta_3 \sum_{\mathrm{n}}^{0} L_{it} + \beta_4 \sum_{\mathrm{n}}^{0} KICT_{it} + \beta_5 \sum_{\mathrm{n}}^{0} KICTS_{it} + \varepsilon_{it}$ (Model 7-2 to Model 7-5); where n is the lag year. In all models, ε_{it} accounts for the part of Y_{it} unexplained by the model.

	Model 7-1: Basic		**Model 7-2: Lag-1**		**Model 7-3: Lag-2**		**Model 7-4: Lag-3**		**Model 7-5: Lag-4**	
Variable	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
C	2.7041	0.0000	0.0987	0.0000	0.0661	0.0000	0.0362	0.0119	0.0322	0.0289
K	0.3374	0.0000	0.1698	0.0000	0.1811	0.0000	0.2152	0.0000	0.2238	0.0000
L	-0.0482	0.4517	0.0882	0.0000	0.0864	0.0000	0.0422	0.0112	-0.0004	0.9836
$KICT$	0.1522	0.0000	-0.0120	0.2168	-0.0142	0.2213	-0.0184	0.1408	-0.0088	0.4818
$\boldsymbol{KICTS}$	0.3470	0.0000	-0.1989	0.0000	-0.1673	0.0051	-0.2036	0.0020	-0.0152	0.8614
$Y(-1)$			0.9825	0.0000	0.9257	0.0000	0.9575	0.0000	0.9370	0.0000
$K(-1)$			-0.1626	0.0000	-0.0844	0.0020	-0.2398	0.0000	-0.2358	0.0000
$L(-1)$			0.0402	0.0290	0.0527	0.0048	0.0263	0.1523	0.0213	0.3022
$KICT(-1)$			0.0121	0.2394	0.0501	0.0472	0.0631	0.0149	-0.0373	0.3684
$\boldsymbol{KICTS(-1)}$			0.1990	0.0000	0.0194	0.8656	0.0312	0.7722	-0.0888	0.4682
$Y(-2)$					0.0646	0.0056	0.0825	0.0120	0.0659	0.1059
$K(-2)$					-0.0907	0.0000	0.2125	0.0000	0.2795	0.0000
$L(-2)$					0.0577	0.0018	0.0450	0.0120	0.0451	0.0179
$KICT(-2)$					-0.0377	0.0789	-0.0608	0.0827	0.1231	0.0134
$\boldsymbol{KICTS(-2)}$					0.1451	0.0234	0.0915	0.4364	0.2848	0.0094

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Variable	Model 7-1:Basic		Model 7-2: Lag-1		Model 7-3: Lag-2		Model 7-4: Lag-3		Model 7-5: Lag-4	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
$Y(-3)$							-0.0430	**0.0679**	0.0013	0.9693
$K(-3)$							-0.1835	**0.0000**	-0.2236	**0.0000**
$L(-3)$							0.0155	0.3780	0.0318	**0.0754**
$KICT(-3)$							0.0129	0.6018	-0.0600	0.2360
$\boldsymbol{KICTS(-3)}$							0.0774	0.2787	-0.6632	**0.0000**
$Y(-4)$									-0.0074	0.7596
$K(-4)$									-0.0405	**0.0235**
$L(-4)$									0.0039	0.8205
$KICT(-4)$									-0.0194	0.5148
$\boldsymbol{KICTS(-4)}$									0.4806	**0.0000**
$\overline{R^2}$	0.6251		0.9889		0.9915		0.9941		0.9958	

Note: the blank cells mean that the variables are not included in the model

Table 7-4: Complementary other capital with ICT service capital: Basic, lag-1 to lag-4 model

This table reports coefficient and probability estimates and the model's adjusted R-squared for Model 7-6 to Model 7-15. Model 7-6and Model 7-11are the basic model of complementary effect between $KICTS$ and K also L, while Model 7-7 to Model 7-10and Model 7-12 to Model 7-15are the lag-1 to lag-4 models. The models are: $Y_{it} = C + \beta_1 K_{it} * KICTS_{it} + \beta_2 L_{it} * KICTS_{it} + \varepsilon_{it}$ (Model 7-6) and (Model 7-11); $Y_{it} = C + \beta_1 \sum_{n}^{1} Y_{it} + \beta_2 \sum_{n}^{0} K_{it} * KICTS_{it} + \beta_3 \sum_{n}^{0} L_{it} * KICTS_{it} + \varepsilon_{it}$ (Model 7-7 to Model 7-10); $Y_{it} = C + \beta_1 K_{i(t-n)} * KICTS_{i(t-n)} + \beta_2 L_{i(t-n)} * KICTS_{i(t-n)} + \varepsilon_{it}$ (Model 7-12 to Model 7-15),where n is the lag year. In all models, ε_{it} accounts for the part of Y_{it} unexplained by the model.

	Model 7-6		Model 7-7		Model 7-8		Model 7-9		Model 7-10	
Variable	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
C	2.0666	**0.0000**	1.9213	**0.0000**	1.8994	**0.0000**	1.8854	**0.0000**	1.8134	**0.0000**
$K * KICTS$	0.3894	**0.0000**	0.5663	0.8175	0.5676	**0.0000**	0.6327	**0.0000**	0.6361	**0.0000**
$L * KICTS$	0.0680	**0.0000**	-0.0155	**0.0392**	-0.0792	0.2728	-0.1105	0.1530	-0.0666	0.4487
$K * KICTS(-1)$			-0.1874	**0.0392**	-0.0212	0.8917	-0.1096	0.5445	-0.1172	0.5920
$L * KICTS(-1)$			0.1039	0.1289	0.2337	**0.0612**	0.2143	0.1221	0.1899	0.2269
$K * KICTS(-2)$					-0.1743	**0.0876**	-0.05	0.7762	-0.0491	0.8183
$L * KICTS(-2)$					-0.0597	0.5532	0.0702	0.6664	0.0588	0.7491
$K * KICTS(-3)$							-0.1077	0.3567	-0.1081	0.5783
$L * KICTS(-3)$							-0.0735	0.5273	-0.0887	0.6280
$K * KICTS(-4)$									-0.0115	0.9312
$L * KICTS(-4)$									0.0237	0.8572
$\overline{R^2}$	0.5984		0.6007		0.5996		0.6004		0.5940	

	Model 7-11		Model 7-12		Model 7-13		Model 7-14		Model 7-15	
Variable	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
C	2.0666	**0.0000**	1.9943	0.0000	2.0665	**0.0000**	2.1269	**0.0000**	2.1259	**0.0000**
$K*KICTS$	0.3894	**0.0000**								
$L*KICTS$	0.0680	**0.0000**								
$K*KICTS(-1)$			0.3762	**0.0000**						
$L*KICTS(-1)$			0.0865	**0.0000**						
$K*KICTS(-2)$					0.3671	**0.0000**				
$L*KICTS(-2)$					0.0892	**0.0000**				
$K*KICTS(-3)$							0.3568	**0.0000**		
$L*KICTS(-3)$							0.0935	**0.0000**		
$K*KICTS(-4)$									0.3388	**0.0000**
$L*KICTS(-4)$									0.1081	**0.0000**
$\overline{R^2}$	0.5984		0.5936		0.5992		0.5711		0.5568	

*Note: the blank cells mean that the variables are not included in the model. If other variables are included, then K*KICTS cannot be calculated.*

Table 7-5: The role of ICT service: Fix-phone, Mobile-phone, Internet and Cloud Computing on SMEs: Basic, lag-1 to lag-4 model

This table reports coefficient and probability estimates and the model's adjusted R-squared for Model 7-16 to Model 7-20. Model 7-16 is the basic model of dis-aggregate ICT services (fix phone, mobile phone, Internet and cloud computing), while Model 7-17 to Model 7-20 are the lag-1 to lag-4 models. The models are: $Y_{it} = C + \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 KICT_{it} + \beta_4 Fix_{it} + \beta_5 Mb_{it} + \beta_6 Int_{it} + \beta_7 Cc_{it} + \varepsilon_{it}$ (Model 7-16); $Y_{it} = C + \beta_1 \sum_{\mathrm{n}}^{1} Y_{it} + \beta_2 \sum_{\mathrm{n}}^{0} K_{it} + \beta_3 \sum_{\mathrm{n}}^{0} L_{it} + \beta_4 \sum_{\mathrm{n}}^{0} KICT_{it} + \beta_5 \sum_{\mathrm{n}}^{0} Fix_{it} + \beta_6 \sum_{\mathrm{n}}^{0} Mb_{it} + \beta_6 \sum_{\mathrm{n}}^{0} Int_{it} + \beta_7 \sum_{\mathrm{n}}^{0} Cc_{it} + \varepsilon_{it}$ (Model 7-17 to Model 7-20); where n is the lag year. In all models, ε_t accounts for the part of Y_t unexplained by the model.

	Model 7-16		Model 7-17		Model 7-18		Model 7-19		Model 7-20	
Variable	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
C	28.9013	0.1086	**0.0381**	0.2571	**0.0021**	0.8852	-0.0011	0.9423	**0.0264**	**0.0945**
K	0.1731	**0.0000**	**0.0324**	0.8684	**0.0283**	0.7685	-0.1489	0.1238	-0.1374	0.1424
L	-0.6724	0.1865	**0.1046**	0.1576	**0.1798**	**0.0001**	**0.1448**	**0.0014**	**0.0691**	0.1352
$KICT$	0.4896	**0.0000**	-0.0839	0.4590	-0.1135	**0.0356**	-0.1714	**0.0067**	-0.0508	0.4222
Fix	6.0784	**0.0046**	**0.3925**	0.4019	-0.2451	0.2659	-0.4341	**0.0518**	-0.3633	0.1032
Mb	0.2412	**0.0000**	-0.1040	0.8380	**0.0596**	0.8004	**0.0732**	0.7602	**0.0671**	0.7814
Int	3.4920	0.1434	**0.0996**	0.8032	**0.1949**	0.3090	**0.0732**	0.7134	**0.0398**	0.8498
Cc	0.0000	0.1495	**0.0571**	0.9015	-0.2581	0.2231	**0.0276**	0.8995	**0.1372**	0.5602
$Y(-1)$			**0.9799**	**0.0000**	**1.0196**	**0.0000**	**1.4231**	**0.0000**	**1.2288**	**0.0000**
$K(-1)$			-0.0298	0.8789	-0.2497	0.1151	**0.0075**	0.9602	-0.0224	0.8911
$L(-1)$			**0.0948**	0.1934	**0.0548**	0.1119	-0.1070	**0.0327**	-0.1183	**0.0206**
$KICT(-1)$			**0.1055**	0.3558	**0.4757**	**0.0004**	**0.4871**	**0.0002**	**0.3294**	**0.0186**
$Fix(-1)$			**0.2927**	0.5146	**0.4950**	**0.0307**	**0.2955**	0.1872	**0.5445**	**0.0184**
$Mb(-1)$			**0.1049**	0.8362	**0.4213**	0.2129	**0.0977**	0.7765	**0.3826**	0.2851
$Int(-1)$			-0.1770	0.7116	-0.2741	0.2132	**0.0148**	0.9470	-0.0773	0.7327
$Cc(-1)$			-0.2969	0.5173	**0.1109**	0.6333	-0.1300	0.5529	-0.0690	0.7612

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	Model 7-16		Model 7-17		Model 7-18		Model 7-19		Model 7-20	
Variable	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
$Y(-2)$					-0.0271	0.3644	-0.4099	**0.0000**	**0.0092**	0.9527
$K(-2)$					**0.2232**	**0.0167**	**0.3199**	**0.0305**	**0.3992**	**0.0077**
$L(-2)$					**0.1178**	**0.0002**	**0.0701**	**0.0264**	**0.1424**	**0.0018**
$KICT(-2)$					-0.3525	**0.0011**	-0.1035	0.5193	**0.0375**	0.8164
$Fix(-2)$					-0.4104	**0.0646**	-0.3201	0.1705	-0.1621	0.4910
$Mb(-2)$					-0.4793	**0.0466**	-0.6263	**0.0495**	-0.5178	0.1129
$Int(-2)$					**0.1266**	0.5659	**0.2142**	0.3138	-0.1341	0.5426
$Cc(-2)$					-0.0098	0.9681	-0.1387	0.5519	-0.3646	0.1089
$Y(-3)$							-0.0180	0.5047	-0.2633	**0.0067**
$K(-3)$							-0.1770	**0.0560**	-0.3962	
$L(-3)$							**0.0064**	0.8411	**0.0187**	0.5300
$KICT(-3)$							-0.2061	**0.0495**	-0.1678	0.2676
$Fix(-3)$							**0.3016**	0.1814	**0.0219**	0.9271
$Mb(-3)$							**0.4562**	**0.0539**	**0.1858**	0.5374
$Int(-3)$							**0.0403**	0.8513	-0.0618	0.7737
$Cc(-3)$							**0.0934**	0.7059	**0.1478**	0.5360
$Y(-4)$									**0.0154**	0.5166
$K(-4)$									**0.1572**	0.1201
$L(-4)$									**0.0170**	0.5721
$KICT(-4)$									-0.1404	0.1596
$Fix(-4)$									-0.0033	0.9883
$Mb(-4)$									-0.1167	0.6242
$Int(-4)$									-0.1898	0.3811
$Cc(-4)$									**0.0075**	0.9767
$\overline{R^2}$	0.8045		0.9975		0.9996		0.9997		0.9998	

Note: the blank cells mean that the variables are not included in the model

Table 7-6: Complementary among ICT services: Basic, lag-1 to lag-4 model

This table reports coefficient and probability estimates and the model's adjusted R-squared for models Model 7-21 to Model 7-25. Model 7-21 is the basic model of dis-aggregate ICT services (fix phone, mobile phone, Internet and cloud computing), while Model 7-22 to Model 7-25 are the lag-1 to lag-4 models. The models are: $Y_{it} = C + \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 KICT_{it} + \beta_4 KICTS_{it} + \beta_5 Fix_{it} * Mb_{it} + \beta_6 Fix_{it} * Int_{it} + \beta_7 Fix_{it} * Cc_{it} + \beta_8 Mb_{it} * Int_{it} + \beta_9 Mb_{it} * Cc_{it} + \beta_{10} Int_{it} * Cc_{it} + \varepsilon_{it}$ (Model 7-21); $Y_{it} = C + \beta_1 K_{it} + \beta_2 L_{it} + \beta_3 KICT_{it} + \beta_4 KICTS_{it} + \beta_5 Fix_{it} * Mb_{it} + \beta_6 Fix_{it} * Int_{it} + \beta_7 Fix_{it} * Cc_{it} + \beta_8 Mb_{it} * Int_{it} + \beta_9 Mb_{it} * Cc_{it} + \beta_{10} Int_{it} * Cc_{it} + \beta_{11} Y_{i(t-n)} + \beta_{12} K_{i(t-n)} + \beta_{13} L_{i(t-n)} + \beta_{14} KICT_{i(t-n)} + \beta_{15} KICTS_{i(t-n)} + \beta_{16} Fix_{i(t-n)} * Mb_{i(t-n)} + \beta_{17} Fix_{i(t-n)} * Int_{i(t-n)} + \beta_{18} Fix_{i(t-n)} * Cc_{i(t-n)} + \beta_{19} Mb_{i(t-n)} * Int_{(t-n)} + \beta_{20} Mb_{i(t-n)} * Cc_{i(t-n)} + \beta_{21} Int_{i(t-n)} * Cc_{i(t-n)} + \varepsilon_t$ (Model 7-22 to Model 7-25); where n is the lag year. In all models, ε_{it} accounts for the part of Y_{it} unexplained by the model.

	Model 7-21		Model 7-22		Model 7-23		Model 7-24		Model 7-25	
Variable	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
C	3.2929	**0.0000**	**4.0494**	0.2545	**6.2305**	0.1702	**5.0435**	0.4028	**5.1125**	0.5171
K	0.1258	**0.0000**	**0.0922**	0.7594	**0.1638**	0.4586	**0.4502**	**0.083**	**0.3875**	0.2849
L	-0.0845	0.1616	**0.0234**	0.8043	**0.2374**	0.1530	**0.0639**	0.7719	**0.1398**	0.6845
$KICT$	0.3871	**0.0000**	-0.1334	0.3920	-0.2072	0.1047	-0.2964	**0.0742**	-0.1834	0.3172
$KICTS$	0.1442	**0.0888**	-0.6901	0.2838	-0.7942	0.1293	-0.5121	0.3083	-0.4842	0.3742
$Fix * Mb$	0.6771	0.7854	**0.0449**	0.9431	-0.0973	0.9071	**0.2992**	0.5382	-1.6584	0.2714
$Fix * Int$	0.1108	**0.0033**	**0.4974**	0.4688	**0.3736**	0.6487	**1.4141**	0.2072	**0.2784**	0.5158
$Fix * Cc$	2.0339	0.3857	**0.4111**	0.4485	**0.7819**	0.2265	-0.6448	0.6085	-0.3503	0.7967
$Mb * Int$	2.3364	0.3242	-0.5352	0.3663	**0.2619**	0.7282	-0.9663	0.3937	-0.3583	0.8026
$Mb * Cc$	-0.6052	0.8085	-0.0001	0.7515	**0.0001**	0.5901	-0.2165	0.8548	**0.8322**	0.6187
$Int * Cc$			**0.9651**	**0.0000**			**0.0001**	0.7152	**0.0003**	0.2925
$Y(-1)$			-0.0928	0.7578						
$K(-1)$			-0.0086	0.9264						
$L(-1)$			**0.1590**	0.3115						
$KICT(-1)$			**0.6774**	0.2945						

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	Model 7-21		Model 7-22		Model 7-23		Model 7-24		Model 7-25	
Variable	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
$Fix * Mb(-1)$			**0.9279**	0.1546						
$Fix * Int(-1)$			**0.0138**	**0.0257**						
$Fix * Cc(-1)$			-0.9324	0.2080						
$Mb * Int(-1)$			-0.5406	0.3795						
$Mb * Cc(-1)$			**0.4833**	0.4379						
$Int * Cc(-1)$			**0.0000**	0.7754						
$Y(-2)$					**0.9518**	**0.0000**				
$K(-2)$					-0.1638	0.4583				
$L(-2)$					**0.0654**	0.5451				
$KICT(-2)$					**0.2459**	**0.0576**				
$KICTS(-2)$					**0.7824**	0.1379				
$Fix * Mb(-2)$					**0.3683**	0.6532				
$Fix * Int(-2)$					**0.0151**	**0.0410**				
$Fix * Cc(-2)$					-1.0773	0.2238				
$Mb * Int(-2)$					-0.7313	0.3306				
$Mb * Cc(-2)$					**0.8951**	0.2701				
$Int * Cc(-2)$					-0.0001	0.5597				
$Y(-3)$							**0.9365**	**0.0000**		
$K(-3)$							-0.448	**0.0839**		
$L(-3)$							**0.1066**	0.4434		
$KICT(-3)$							**0.3483**	**0.0395**		
$KICTS(-3)$							**0.5014**	0.3233		
$Fix * Mb(-3)$							-0.1636	0.8935		
$Fix * Int(-3)$							-0.2796	0.5662		
$Fix * Cc(-3)$							-0.493	0.6751		
$Mb * Int(-3)$							-0.0137	0.9899		
$Mb * Cc(-3)$							**0.6284**	0.5076		
$Int * Cc(-3)$							-0.0001	0.6922		

Variable	Model 7-21		Model 7-22		Model 7-23		Model 7-24		Model 7-25	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
$Y(-4)$									**0.9172**	**0.0000**
$K(-4)$									-0.3843	0.2885
$L(-4)$									-0.0747	0.6618
$KICT(-4)$									**0.2556**	0.1656
$KICTS(-4)$									**0.4717**	0.3890
$Fix * Mb(-4)$									-0.7963	0.5840
$Fix * Int(-4)$									-0.2540	0.5555
$Fix * Cc(-4)$									**0.0608**	0.9693
$Mb * Int(-4)$									**0.6304**	0.6241
$Mb * Cc(-4)$									**0.6508**	0.6042
$Int * Cc(-4)$									-0.0003	0.2804
$\overline{R^2}$	0.8289		0.9962		0.9950		0.9935		0.9917	

Note: the blank cells mean that the variables are not included in the model. NA is the result is not available.

Chapter 8 : The Factors Influencing ICT Services and Adoption of Cloud Computing by SMEs

8.1 Introduction

The findings in previous chapters indicated that ICT services play a significant and positive role in increasing SME output (see Chapter 7), and increasing the national economy over time (see Chapter 5 and Chapter 7). Fixed-line and mobile telephones are the main contributors to this impact. Further study is needed to understand the factors influencing ICT services adoption by SMEs. Therefore, more in-depth recommendations can be proposed to help improve ICT services adoption by SMEs.

This study utilized the primary data, inroduced in Chapter 6, in an analysis that combined two technology adoption frameworks, the TAM, and the Technology, Organisation, and Environment (TOE) framework and covers the five group factors including management, employee, industry, innovation, and other ICT services. Finally, the analysis employed an econometric technique, the probit choice model.

This chapter discusses the factors influencing the adoption of ICT services by SMEs, which relates to Q4. Section 8.2 and Section 8.3 discuss the technology adoption framework and econometric technique applied in this analysis, respectively. The analysis is reported in Section 8.4. Specifically, the Cloud Computing adoption factors, which relate to Q5, are discussed in Section 8.5.

8.2 The Technology Adoption Framework

TAM is the most prominent adoption model used to evaluate the individual acceptance level of a technology. It is based on five variables: (1) perceived usefulness (PU); (2) perceived ease of use (PEU); (3) attitude toward use; (4) intention to use; and (5) actual use (Davies, 1989). TAM was first developed to examine the adoption of computers. Researchers then applied

TAM to investigate the adoption of other new technologies such as mobile telephones, Internet and even Cloud Computing (Rudito, 2010; Mohabbattalab et al., 2014).

On the other hand, the TOE framework is commonly used to examine technology adoption at the business level. It examines the factors influencing technology implementation in a business through three context: technological, organizational, and environmental (Tornatzky and Fleischer 1990, Oliviera and Martins, 2011). Researchers have used this framework to investigate the utilisation of various technologies by SMEs (Low at al., 2011; Alshamila et al., 2013; Erisman, 2013; Olivera et al., 2014; Wu et al., 2013, Borgan et al., 2013, Morgan and Conboy, 2013, Hsu et al., 2014, Lian et al., 2014, Seethamraju, 2014).

SMEs are simple organisations, and most are self-managed by the owner (Tambunan, 2008). However, they are usually labour-intensive (Tambuan, 2009). Here, SMEs can be viewed as a combination of individual and organisational perspectives. Therefore, this study incorporated TAM for the individual perspective, and used the TOE approach for the organizational focus, to determine the influence of selected factors (adoption group factors). The mapping of the TOE variables to the TAM aspects is as follows:

1. Perceived usefulness - organisation, in this study is represented by the management factors;
2. Ease of use - organisation, in this study is covered in the employee factors;
3. Attitude toward use - environment and organisation, in this study is included in the industry factors;
4. Intention to use – technology and environment, in this study is represented by the innovation factors;
5. Actual Use - technology, in this study is covered in the other ICT services factors.

Figure 8-1 depicts five group factors examined in this study that resulted from the mapping of the TAM and TOE approaches.

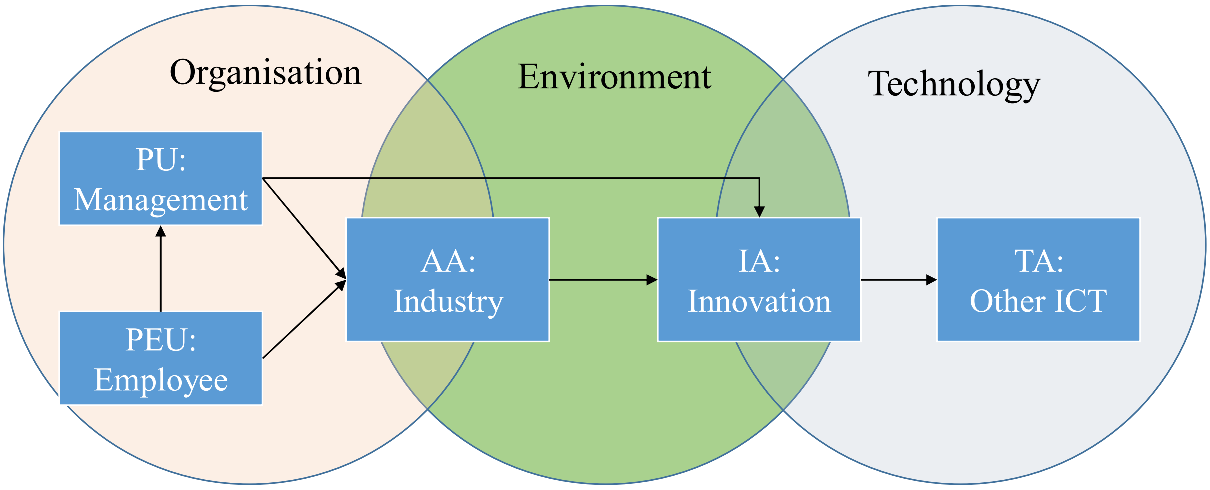

Figure 8-1: The TAM and TOE Mapping for influence factor identification (group factors)

The first group factor, the management factors, cover gender (mg: male and female), management age (ma: less than 30 years, 30 to 40 years, 40 to 50 years, 50 to 60 years, and over 60 years), and education (me: less than high school, high school, and degree or university).

The second group factor is the employee factors covering employee age (ea: less than 30 years, 30 to 40 years, 40 to 50 years, and over 50 years), employee education (ee: less than high school, high school, and degree or university), and employee ICT literacy ($eict$: low, medium, and high).

The third group factor is industry factors covering the business types (bt), years in business or business maturity (bm), business scale (bs: micro, small and medium), and the business location or city (bl: Jakarta, Bandung, Semarang, and Denpasar). The business types are further broken down into four variables: (a) BRT (retail): SMEs which sell products or services to individual or mass consumers, (b) BW (wholesale): SMEs which sell bulk products or services to consumers, (c) BRS (re-seller): SMEs which sell products or services either in bulk or individually sourced from other businesses, (d) BA (assembly): SMEs which produce and sell their own products or services.

Innovation factors constitute the fourth group factor covering whether the business understands its competitors (kc), whether it conducts continuous improvement (ci) and whether it conducts research and development (rd). Continuous improvement covers product improvement, business process improvement, and customer service improvement. R&D includes market research and new product development.

The last group factor is the ICT and other ICT services used by businesses. The ICT components are computers (com), while the ICT services are: fixed-line telephones (fix), mobile telephones (mb), Internet (int) and Cloud Computing (cc).

8.3 The Binary Choice Probit Model

A binary choice probit method permits the study of the impact of different factors on a binary choice variable. Binary choice variables can commonly be used as explanatory variables to predict the value of an outcome variable. Various studies from many disciplines have used this method to explore adoption factors. Medonka et al. (2015) used the probit model method to study ICT penetration inequality in a network society. The probit model was also used by Youssef et al. (2011) to examine intra-firm diffusion of innovation.

The dependent variable of a binary choice probit model is the individual utility of two possible choices, usually denoted by 0 and 1. Therefore, if the probability of taking the value of $y = 1$ is p, then the probability of $y = 0$ is $(1 - p)$. The model of y as a function of the explanatory variables (x), the expected value of y (conditional on the values of x) is:

$$E(y|x) = \Pr(y = 1|x) = F(x; \beta) \tag{8-1}$$

where y is the output, x is the explanatory variable and β is the regression coefficient.

Then the basic equation of the binary choice probit model is as follows:

$$y_i^* = x_i' \beta + u_i , i = 1, \dots , n \tag{8-2}$$

y_i^* is unobserved outcome, x_i' is $k \ x \ 1$ vector of regressors as the explanatory variable, β is $k \ x \ 1$ vector of coefficients, and u_i is the residual error that follows a normal distribution. Coefficients (β) reveals the change in the outcome variable (y) for a 1-unit change in the explanatory variable (x).

The observed y_i is determined as follows:

$$y_i = \begin{cases} 1 & if \ \ y_i^* > 0, \\ 0 & if \ \ otherwise \end{cases} \tag{8-3}$$

However, the coefficient sign shows only the direction of the effect. Marginal effect reveals the value of a change in propensity of y_i^*.

The marginal effect for a binary independent variable is:

$$x_k = \frac{\partial \, Prob(y_i = 1|x_i)}{\partial \, x_{ik}} = \frac{\partial \, F(x'_i\beta)}{\partial x_{ik}} = F'(x'_i\beta)\beta_k \tag{8-4}$$

where the change in the probability of y_i=1 given a 1-unit change in x_{ik}. This study applied average marginal effect (AME), where the individual marginal effect for every single person in the sample (at their particular value of x_i) was calculated first, and then this was averaged out for everyone in the sample.

To investigate the factors affecting ICT services adoption on SMEs, a two-stage binary choice probit model was applied. The ICT services adoption examined covered fixed-line telephones (fix), mobile telephones (mb), the Internet (int) and Cloud Computing (cc). The data used is from the primary dataset as explained in Chapter 6. The estimation was applied per ICT services component (fix, mb, int, cc).

The factors examined in this study were grouped into five group factors, as explained in Section 8.2. Two-stage analyses were applied in this study. In stage 1, the analysis was applied per group factor. In stage 2, all factors in one model were considered. The models were developed based on the variables and group factors as explained in Section 8.2 and Table 8-1 below.

Table 8-1: The ICT services adoption variables

Group Factor	Variable
1. Management	1.1 mg: management gender (male and female) 1.2 ma: management age (less than 30 years, 30 to 40 years, 40 to 50 years, 50 to 60 years, and over 60 years) 1.3 me: management education (less than high school, high school, and degree or university).
2. Employee	2.1 ea:employees' age (less than 30 years, 30 to 40 years, 40 to 50 years, and over 50 years) 2.2 ee: employees' education (less than high school, high school, and degree or university) 2.3 $eict$: employee's ICT literacy (low, medium, and high).
3. Industry	3.1 3.1 $\boldsymbol{bt}$: business types (retail, wholesale, reseller, assembly) 3.2 $\boldsymbol{bm}$: years in business or business maturity (> 10 yrs, 5-10 yrs, 1-5 yrs, <1 yrs) 3.3 $\boldsymbol{bs}$: business size (micro, small and medium) 3.4 $\boldsymbol{bl}$: the firm's location or city (Jakarta, Bandung, Semarang, and Denpasar).
4. Innovation	4.1 $\boldsymbol{kc}$: the firm understands their competitors 4.2 $\boldsymbol{ci}$: whether they conduct continuous improvement or not 4.3 $\boldsymbol{rd}$: whether they conduct research and development.
5. Other ICT services	5.1 $\boldsymbol{com}$: computer 5.2 $\boldsymbol{fix}$: fix telephone 5.3 $\boldsymbol{mb}$: mobile telephone 5.4 $\boldsymbol{int}$: Internet 5.5 $\boldsymbol{cc}$: cloud computing

In stage 1, the estimation was done for each group of factors. The model for the management factors, employee factors, industry factors, and innovation factors are explained in equations (8-5), (8-6), (8-7), and (8-8), respectively:

$$ICTS_i = c + \beta_1 mg_i + \beta_2 ma_i + \beta_3 me_i + u_i \tag{8-5}$$

$$ICTS_i = c + \beta_1 ea_i + \beta_2 ee_i + \beta_3 eict_i + u_i \tag{8-6}$$

$$ICTS_i = c + \beta_1 bt_i + \beta_2 bm_i + \beta_3 bs_i + \beta_4 bl_i + u_i \tag{8-7}$$

$$ICTS_i = c + \beta_1 mg_i + \beta_2 ma_i + \beta_3 me_i + u_i \qquad (8\text{-}8)$$

In the other ICT services group factor, the ICT service being examined was set as the dependent variable, while, the other ICT services were the explanatory factors. The model below is an example of Cloud Computing adoption (cc), with other ICT services being considered as the factors examined (fixed-line telephone - fix, mobile telephone - mb, and Internet - int).

$$cc_i = c + \beta_1 com_i + \beta_2 fix_i + \beta_3 mb_i + \beta_4 int_i + u_i \qquad (8\text{-}9)$$

In the second stage, all factors were included in the one equation. The model below is an example for Cloud Computing adoption (cc):

$$\begin{aligned} cc_i = c + {} & \beta_1 mg_i + \beta_2 ma_i + \beta_3 me_i + \beta_4 bt_i + \beta_5 bm_i + \beta_6 bs_i \\ & + \beta_7 bl_i + \beta_8 ea_i + \beta_9 ee_i + \beta_{10} eict_i + \beta_{11} kc_i \\ & + \beta_{12} ci_i + \beta_{13} rd_i + \beta_{14} com_i + \beta_{15} fix_i + \beta_{16} mb_i \\ & + \beta_{17} int_i + u_i \end{aligned} \qquad (8\text{-}10)$$

The results from stage 1 and stage 2 were then compared to summarise the findings.

8.4 Factors Affecting ICT Services Adoption

The aim of this study was to find the factors influencing the adoption of ICT services by SMEs. It used the primary data that is explained in Chapter 6. Table 8-2 presents a summary of the primary data for the analysis. This study applied a two-stage analysis, as explained in Section 8.3.

8.4.1 Fixed-line telephone

The global trend from the secondary data and the field survey of Indonesian SMEs indicates that fixed-line telephones are in their mature phase. However, they still play a significant role in supporting SME businesses, as can be seen in the primary data where 106 (26.57%) out of 399 SMEs use fixed-line telephones.

The analysis began with the stage 1 results presented in Table 8-3. Model 8-1 to Model 8-34 examined per group factors, based on equations (8-5) to (8-9) explained in Section 8.3. Of the management factors covered in the analysis, gender and management education did not determine the utilization of fixed-line telephones. In terms of age, management personnel who were 30-40 years old and 50-60 years old (11% and 19.2% respectively) were more inclined to use fixed-line telephones compared to those who were less than 30 year old. The factors in the industry factor group were significant. Of the business types covered in the study, fixed-line telephones adoption in BRT was 14% more than BRS, while BA was 53% and 47% more than BRS and BW, respectively. The more mature the business, the more it preferred to use fixed-line telephones. Businesses that were more than 10 years old were13% and 29% more willing to use fixed-line telephones compared to 5-10 year old and 1-5 year old firms, respectively. Meanwhile, 5-10 year old businesses were 16% more than the 1-5 year old businesses. Larger firms utilized fixed-line telephones more than smaller firms. Medium-sized firms were 26% and 15% more inclined to adopt fixed-line telephones compared to micro and small firms, respectively. Firms located in Jakarta used fixed-line telephones less than did the other cities with Bandung (17%), Semarang (16%) and Denpasar (35%) On the other hand, businesses in Denpasar used fixed-line telephones the most. Denpasar fixed line telephone usage was 17% and 19% more than in Semarang and Bandung, respectively. As for the employee factors, all were significant. Younger employees (less than 30 years old) used fixed-line telephones more than did the older employees. On the other hand, those with a higher education level (university degree) adopted fixed-line telephones more than those with lower education levels. In contrast, employees with lower ICT skill levels were more willing to use fixed-line telephones than those with higher level skills. Competitor knowledge and continuous improvement were two significant factors from the group of innovation factors. The firms which are aware of their competitors and firms which innovate continuously were 26% and 10% more likely to adopt fixed-line telephones than were the firms that only undertake R&D. Firms that used Cloud Computing were also more likely to use fixed-line telephones. In contrast, the firms that used mobile telephones were less likely to use fixed-line telephones. A possible explanation for this might be that fixed-line and mobile telephones have similar functions, and Cloud Computing complements fixed-line telephones.

The stage 2 results from models Model 8-5 to Model 8-8 are presented in Table 8-4. The following findings can be concluded.

Similar to the stage 1 result, young management (less than 30 years) were less likely to use fixed-line telephones than were the middle-aged management (30-40 years), with a differential of 12%. Management gender and management education were found to be insignificant factors in this stage. Models in this stage also confirmed the stage 1 results: that BA were the most likely business type to use fixed-line telephones. Similar results to the stage 1 findings were also found for the other business factors: business maturity, business scale and location. The larger and more mature a business, the more willing it was to adopt fixed-line telephones. Businesses in Jakarta were the least likely to use fixed-line telephones, while those in Denpasar were the most likely to adopt fixed-line telephones. Employee age was not a significant factor in this model, while employees who were high school graduates were less likely to use fixed-line telephones compared to other levels of education. This finding is somewhat in line with the stage 1 finding, where employees with university degrees were the most likely to prefer to use fixed-line telephones. In terms of employee ICT skill, the finding confirms the stage 1 finding, that lower ICT skill employees were more likely to use Cloud Computing. The models in this stage show that only competitor knowledge (from the innovation factors) determined the utilisation of fixed-line telephones. Confirming the finding in the stage 1 models, the stage 2 models also found that businesses with mobile telephones were less likely to use fixed-line telephones compared to other ICT services.

Table 8-2: Summary of the Adoption Factors data

Variable		Description	N	%
i. Management group Factors				
Management gender	mg	Dummy with value 1 if the respondent/ management is male	251	62.91%
Management Age	ma	Age (respondent)		
18-30 years	$ma30$	Dummy with value 1 if the respondent/ management age is between 18 to 30 years	98	24.56%
31-40 years	$ma3040$	Dummy with value 1 if the respondent/ management age is between 31 to 40 years	176	44.11%
41-50 years	$ma4050$	Dummy with value 1 if the respondent/ management age is between 41 to 50 years	89	22.31%
51-60 years	$ma5060$	Dummy with value 1 if the respondent/ management age is between 51 to 60 years	25	6.27%
>60 years	$ma60$	Dummy with value 1 if the respondent/ management age is > 60 years	11	2.76%
Management Education	me	Education (respondent / Management)		
< High School	$melhs$	Dummy with value 1 if the respondent is the Management Education less than High School	78	19.55%
High School	$mehs$	Dummy with value 1 if the respondent is the Management Education is High School	254	63.66%
University Degree	meu	Dummy with value 1 if the respondent is the Management Education University level	67	16.79%
ii. Employee group Factors				
Employee Age	ea	Employee age		
18-30 years	$ea30$	Dummy with value 1 if the respondent is the Employee age < 30 years	311	55.54%
31-40 years	$ea3040$	Dummy with value 1 if the respondent is the Employee age 30-40 years	197	35.18%
41-50 years	$ea4050$	Dummy with value 1 if the respondent is the Employee age 41-50 years	43	7.68%
> 50 years	$ea5060$	Dummy with value 1 if the respondent is the Employee age > 51 years	9	1.61%
Employee Education	ee	Employee Education		

Variable		Description	N	%
< High School	$eelhs$	Dummy with value 1 if the respondent is the Employee Education less than High School	125	25.77%
High School	$eehs$	Dummy with value 1 if the respondent is the Employee Education High School	306	63.09%
University Degree	eeu	Dummy with value 1 if the respondent is the Employee Education University graduated	54	11.13%
Employee ICT Skill	$eict$	Employee ICT literacy		
Low	$eictl$	Dummy with value 1 if the respondent is the Employee ICT literacy Low	117	27.34%
Medium - Meet Requirement	$eictm$	Dummy with value 1 if the respondent is the Employee ICT literacy Meet Requirement	289	67.52%
High	$eicth$	Dummy with value 1 if the respondent is the Employee ICT literacy High	22	5.14%
iii. **Industry group Factors**				
Business Type	bt	Business type		
Retail	brt	Dummy with value 1 if the SME is in Retail Business	90	22.56%
Wholesale	bw	Dummy with value 1 if the SME is in Wholesale Business	180	45.11%
Reseller	brs	Dummy with value 1 if the SME is in Reseller Business	120	30.08%
Assembly	ba	Dummy with value 1 if the SME is in Assembly or Production Business	3	0.75%
Business Size	Sc	Business size		
Micro	smi	Dummy with value 1 if the SME scale is Micro	67	16.79%
Small	scs	Dummy with value 1 if the SME scale is Small	203	50.88%
Medium	sme	Dummy with value 1 if the SME scale is Medium	128	32.08%
Business Maturity	bm	Years in business		
> 10 years	$y1$	Dummy with value 1 if the SME has been in business for > 10 years	50	12.53%
5-10 years	$y2$	Dummy with value 1 if the SME has been in business for 5-10 years	177	44.36%
1-5 years	$y3$	Dummy with value 1 if the SME has been in business for 1-5 years	149	37.34%
<1 years	$y4$	Dummy with value 1 if the SME has been in business for < 1 year	23	5.76%
Business Location	bl	The location of SMEs head quarter		
Jakarta	J	Dummy with value 1 if the SME is in Jakarta	200	50.13%

Variable		Description	N	%
Bandung	B	Dummy with value 1 if the SME is in Bandung	100	25.06%
Semarang	S	Dummy with value 1 if the SME is in Semarang	50	12.53%
Denpasar	D	Dummy with value 1 if the SME is in Denpasar	49	12.28%
***iv.* Innovation Group Factor**				
Improvement	im	Dummy with value 1 if the SME did Regular improvement	310	77.69%
Research and Development	rd	Dummy with value 1 if the SME did R&D	239	59.90%
Competitor knowledge	cp	Dummy with value 1 if the SME did Knowledge of competitors	358	89.72%
ICT		The use of ICT services		
***v.* Other ICT Group Factor**				
Computer	Com	Dummy with value 1 if the SME used Computer	126	31.58%
Fix phone	Fix	Dummy with value 1 if the SME used Fix telephone	106	26.57%
Mobile phone	Mb	Dummy with value 1 if the SME used Mobile	383	95.99%
Internet	Int	Dummy with value 1 if the SME used Internet	230	57.64%
Cloud computing	Cc	The use of cloud computing	111	27.82%
SaaS	$SaaS$	Dummy with value 1 if the SME used Software as service	87	21.80%
IaaS	$IaaS$	Dummy with value 1 if the SME used Infrastructure as a service	7	1.75%
PaaS	$PaaS$	Dummy with value 1 if the SME used Platform as a service	14	3.51%

Source: Primary data (survey result)

Table 8-3: Stage 1 Result for Fixed-line Telephone

This table shows probit regression of factors affecting the Fix Telephone adoption (fix) on SMEs, from five factor groups: (i) management, (ii) industry, (iii) employee, (iv) innovation, and (v) Other ICT. The models were estimated per each group separately, using the following equations:

$(\boldsymbol{i})\boldsymbol{fix_i} = \boldsymbol{c} + \beta_1 \boldsymbol{mg_i} + \beta_2 \boldsymbol{ma_i} + \beta_3 \boldsymbol{me_i}$; (ii) $\boldsymbol{fix_i} = \boldsymbol{c} + \beta_1 \boldsymbol{ea_i} + \beta_2 \boldsymbol{ee_i} + \beta_3 \boldsymbol{eict_i}$; $\boldsymbol{fix_i} = \boldsymbol{c} + \beta_1 \boldsymbol{by_i} + \beta_2 \boldsymbol{bm_i} + \beta_3 \boldsymbol{sc_i} + \beta_4 \boldsymbol{bl_i}$; (iii) $\boldsymbol{fix_i} = \boldsymbol{c} + \beta_1 \boldsymbol{by_i} + \beta_2 \boldsymbol{bm_i} + \beta_3 \boldsymbol{sc_i} + \beta_4 \boldsymbol{bl_i}$; (iv) $\boldsymbol{fix_i} = \boldsymbol{c} + \beta_1 \boldsymbol{cp_i} + \beta_2 \boldsymbol{im_i} + \beta_3 \boldsymbol{rd_i}$; (v) $\boldsymbol{fix_i} = \boldsymbol{c} + \beta_1 \boldsymbol{com_i} + \beta_2 \boldsymbol{mb_i} + \beta_3 \boldsymbol{int_i} + \beta_4 \boldsymbol{cc_i}$

Variable	Model 8-1			Model 8-2			Model 8-3			Model 8-4		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
i. **Management**												
Gender (male)	-0.042	0.767	-0.014	-0.042	0.767	-0.014	-0.042	0.767	-0.014	-0.042	0.767	-0.014
Management Age												
Less than 30 yrs	R	R	R	-0.339	0.058	-.1101*	-0.306	0.137	-0.099	-0.592	0.044	-.1920**
30-40 yrs	0.339	0.058	0.110*	R	R	R	0.033	0.850	0.011	-0.252	0.358	-0.082
40-50 yrs	0.306	0.137	0.099	-0.033	0.850	-0.011	R	R	R	-0.285	0.325	-0.093
50-60 yrs	0.592	0.044	0.192**	0.252	0.358	0.082	0.285	0.325	0.093	R	R	R
More than 60 yrs	-0.474	0.384	-0.154	-0.813	0.128	-0.264	-0.780	0.152	-0.253	-1.066	0.068	-.3458*
Management Education												
Less than High School	R	R		-0.026	0.885	-0.009	-0.318	0.159	-0.103	-0.318	0.159	-0.103
High School	0.026	0.885	0.009	R	R	R	-0.291	0.112	-0.095	-0.291	0.112	-0.095
Degree (University)	0.318	0.159	0.103	0.291	0.112	0.095	R	R	R	R	R	R
ii. **Employee**												
Age												
Less than 30 yrs	R	R	R	0.378	0.040	.1219369**	0.420	0.029	.1363246**	0.447	0.023	.1451911**
30-40 years	-0.077	0.587	-$0.025	R	R	R	0.083	0.576	$0.027	0.106	0.482	$0.034
40-50 years	0.081	0.712	$0.026	0.130	0.564	$0.042	R	R	R	0.276	0.221	$0.089
More than 50 yrs	0.423	0.326	$0.138	0.476	0.283	$0.154	0.670	0.135	$0.217	R	R	R
Education												
Less than High School	R	R	R	-0.072	0.698	-$0.023	-0.350	0.152	-$0.113	-0.325	0.180	-$0.105
High School	-0.157	0.387	-$0.051	R	R	R	-0.357	0.150	-$0.116	-0.335	0.173	-$0.109
Degree (University)	0.527	0.011	.1713323**	0.484	0.017	.1564511**	R	R		R	R	R
ICT level												
Low	R	R	R	0.451	0.016	.1457447**	0.545	0.021	.1768436**	0.510	0.031	.1653732**
Medium	-0.139	0.434	-$0.045	R	R	R	0.197	0.394	$0.064	0.182	0.433	$0.059
High	-0.061	0.844	-$0.020	-0.005	0.986	-$0.002	R	R	R	R	R	R

Variable	Model 8-1			Model 8-2			Model 8-3			Model 8-4		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
iii. **Industry**												
Business type	R	R	R	0.263	0.186	0.080	0.461	0.044	0.141**	-1.273	0.102	-0.388
BRT	-0.269	0.177	-0.082	R	R	R	0.197	0.286	0.060	-1.535	0.045	-.468**
BW	-0.460	0.044	-0.140**	-0.197	0.286	-0.060	R	R	R	-1.736	0.024	-.529**
BRS	1.276	0.102	0.390	1.534	0.046	0.468**	1.731	0.025	0.528**	R	R	R
BA												
Years in Business	R	R	R	0.417	0.066	.1271479*	0.950	0.000	.2897998***	0.611	0.131	0.186
More than 10 yrs	-0.428	0.059	-.1306332*	R	R	R	0.533	0.005	.1626519***	0.209	0.565	0.064
5-10 years	-0.962	0.000	-0.294***	-0.533	0.005	-.163***	R	R	R	-0.326	0.369	-0.099
1-5 years	-0.653	0.104	-0.200	-0.207	0.568	-0.063	0.326	0.369	0.099	R	R	R
Less than 1 year												
Scale	R	R	R	-0.414	0.126	-0.126	-0.414	0.126	-0.126	-0.910	0.002	-0.277***
Micro	0.348	0.185	0.106	R	R	R	0.484	0.010	.1476505***	-0.500	0.007	-.153***
Small	0.841	0.004	.2567008***	0.484	0.010	0.148***	R	R	R			
Medium												
City	R	R	R	-0.597	0.009	-0.182***	-0.524	0.031	-.1599789**	-1.176	0.000	-.359***
Jakarta	0.576	0.011	.1759015**	R	R	R	0.073	0.799	0.022	-0.574	0.038	-.175**
Bandung	0.534	0.028	.1631384**	-0.073	0.799	-0.022	R	R	R	-0.653	0.025	-.199**
Semarang	1.164	0.000	.3554749***	0.571	0.038	.1741353**	0.644	0.027	.1963827**	R	R	R
Denpasar												
iv. **Innovation**												
Competitor Knowledge	R	R	R	0.860	0.005	.2774111***	0.821	0.007	.263824***			
Improvement	0.374	0.045	.1218734**	R	R	R	0.321	0.065	.1031769*			
R&D	0.036	0.812	0.0117354	0.079	0.573	0.0255206	R	R	R			
v. **ICT**												
Computer	R	R	R	0.132	0.448	0.043	0.091	0.565	0.029	0.314	0.060	0.102
Mobile phone	-1.540	0.000	-0.499	R	R	R	-1.588	0.000	-0.515	-1.631	0.000	-0.531
Internet	-0.132	0.367	-0.043	-0.263	0.099	-0.085	R	R	R	-0.168	0.294	-0.055
Cloud Computing	0.477	0.002	0.155	0.477	0.002	0.155	0.411	0.010	0.133	R	R	R

Note: R refers to the dummy variable

Table 8-4: Stage 2 Result for Fix Phone (fix)

This table explains probit regression of factors affecting the Fix Phone adoption (fix) on SMEs, from similar factors as in table 1. However, the models in this table were estimated using one equation for all factors:

$$\boldsymbol{fix_i} = \boldsymbol{c} + \beta_1 \boldsymbol{mg_i} + \beta_2 \boldsymbol{ma_i} + \beta_3 \boldsymbol{me_i} + \beta_5 \boldsymbol{ea_i} + \beta_6 \boldsymbol{ee_i} + \beta_7 \boldsymbol{eict_i} + \beta_8 \boldsymbol{by_i} + \beta_9 \boldsymbol{bm_i} + \beta_{10} \boldsymbol{sc_i} + \beta_{11} \boldsymbol{bl_i} + \beta_{12} \boldsymbol{cp_i} + \beta_{13} \boldsymbol{im_i} + \beta_{14} \boldsymbol{rd_i} + \beta_{15} \boldsymbol{com_i} + \beta_{16} \boldsymbol{mb_i} + \beta_{17} \boldsymbol{int_i} + \beta_{18} \boldsymbol{cc_i}$$

Variable	Model 8-5			Model 8-6			Model 8-7			Model 8-8		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
i. **Management**												
Gender (male)	0.130	0.445	0.038	0.050	0.764	0.015	0.041	0.815	0.012	0.035	0.842	0.010
Management Age												
30	R	R	R	-0.246	0.289	-0.071	-0.178	0.504	-0.050	-0.275	0.502	-0.077
30-40	0.402	0.094	.118608*	R	R	R	0.256	0.227	0.073	0.152	0.687	0.043
40-50	0.089	0.743	0.026	-0.211	0.332	-0.061	R	R	R	-0.206	0.580	-0.058
50-60	0.192	0.641	0.057	0.020	0.956	0.006	0.239	0.526	0.068	R	R	R
>60	-1.129	0.072	-.3329627*	-1.451	0.017	-.418**	-1.078	0.074	-.305*	-1.408	0.035	-.394**
Management Education												
Less than High School	R	R	R	-0.322	0.250	-0.093	-0.517	0.171	-0.147	-0.519	0.173	-0.145
High School	0.663	0.038	.1954223**	R	R	R	0.012	0.961	0.003	0.031	0.904	0.009
Degree (University)	0.522	0.187	0.154	0.001	0.998	0.000	R	R	R	R	R	R
ii. **Employee**												
Age												
Less than 30 yrs	R	R	R	0.227	0.316	0.065	0.097	0.690	0.027	0.176	0.478	0.049
30-40 years	-0.124	0.518	-0.037	R	R	R	-0.128	0.515	-0.036	-0.054	0.790	-0.015
40-50 years	0.383	0.187	0.113	0.278	0.331	0.080	R	R	R	0.430	0.139	0.120
More than 50 yrs	0.189	0.728	0.056	-0.029	0.959	-0.008	0.048	0.937	0.014	R	R	R
Education												
Less than High School	R	R	R	0.341	0.199	0.098	-0.025	0.938	-0.007	-0.027	0.931	-0.008
High School	-0.672	0.019	-.1982163**	R	R	R	-0.690	0.037	-.1955704**	-0.725	0.027	-.2032304**
Degree (University)	0.231	0.450	0.068	0.180	0.541	0.052	R	R	R	R	R	R
ICT level												
Low	R	R	R	0.643	0.015	.1854516**	0.890	0.004	.2522949***	0.861	0.005	.2411813***
Medium	0.056	0.812	0.016	R	R	R	0.373	0.184	0.106	0.360	0.204	0.101
High	-0.592	0.172	-0.175	-0.113	0.793	-0.033	R	R	R	R	R	R

Variable	Model 8-5			Model 8-6			Model 8-7			Model 8-8		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
iii. **Industry**												
Business type	R	R	R	0.105	0.650	0.030	0.345	0.236	0.098	-1.449	0.085	-.406*
BRT	-0.087	0.712	-0.026	R	R	R	0.246	0.250	0.070	-1.537	0.061	-.430*
BW	-0.320	0.283	-0.094	-0.149	0.473	-0.043	R	R	R	-1.772	0.033	-.496**
BRS	1.287	0.125	0.380	1.424	0.067	.4104688*	1.689	0.042	.4785998**	R	R	R
BA												
Years in Business	R	R	R	0.542	0.029	.1562015**	1.065	0.000	.3018875***	0.638	0.182	0.179
More than 10 yrs	-0.669	0.008	-.197***	R	R	R	0.425	0.056	.1204448*	-0.009	0.984	-0.002
5-10 years	-1.112	0.000	-.328***	-0.381	0.079	-.109742*	R	R	R	-0.420	0.322	-0.118
1-5 years	-0.652	0.154	-0.192	0.056	0.893	0.016	0.398	0.342	0.113	R	R	R
Less than 1 year												
Scale	R	R	R	-0.322	0.267	-0.093	-0.888	0.012	-.2516461**	-0.909	0.010	-.255***
Micro	0.426	0.157	0.126	R	R	R	-0.418	0.064	-.1184885*	-0.416	0.066	-.116*
Small	0.890	0.009	.2625612***	0.519	0.023	.1496356**	R	R	R	R	R	R
Medium												
City	R	R	R	-0.610	0.033	-.176**	-0.085	0.800	-0.024	-1.269	0.000	-.355***
Jakarta	0.494	0.075	.1456101*	R	R	R	0.467	0.265	0.132	-0.785	0.019	-.220**
Bandung	0.464	0.136	0.137	-0.450	0.263	-0.130	R	R	R	-1.226	0.005	-.344***
Semarang	1.263	0.000	.3724871***	0.756	0.020	.2179071**	1.136	0.010	.321987***	R	R	R
Denpasar												
iv. **Innovation**												
Competitor Knowledge	R	R	R	1.050	0.011	.3026912***	1.043	0.012	.2955728***	1.130	0.008	.3165828***
Improvement	0.378	0.124	0.111	R	R	R	0.343	0.197	0.097	0.375	0.165	0.105
R&D	-0.199	0.425	-0.059	-0.044	0.862	-0.013	R	R	R	R	R	R
v. **ICT**												
Computer	R	R	R	0.202	0.369	0.058	0.196	0.355	0.055	0.322	0.149	0.090
Mobile phone	-1.772	0.000	-.522***	R	R	R	-1.746	0.000	-.4945***	-1.833	0.000	-.513***
Internet	-0.074	0.685	-0.022	-0.200	0.300	-0.058	R	R	R	-0.187	0.345	-0.052
Cloud Computing	0.167	0.412	0.049	0.099	0.624	0.029	0.037	0.860	0.010	R	R	R

Note: R refers to the dummy variable

8.4.2 Mobile Telephones

According to the primary data presented in Chapter 4, 95.99% of businesses (383 out of 399) used mobile telephones. The global trend from the secondary data and the literature also indicated that the number of mobile telephone users was increasing sharply due to the lack of landline infrastructure (Turen et al. 2016; Ghani, S.; 2015, Dedrick et al., 2011). The analysis for mobile telephone adoption in this research applied similar data and techniques as that for the fixed-line telephone adoption explained in the previous sub-section. However, the dependent variable in this analysis was mobile telephone utilisation (mb), and fixed-line telephones were one of the explanatory variables in the ICT group factor. The results are presented in Table 8-5 and Table 8-6.

To begin with, Model 8-9 to Model 8-12 presented in Table 8-5 indicate that none of the management factors determined the adoption of mobile telephones. Next, from the industry group factors, the business maturity was not significant, while other factors were significant. BRT was the business type least likely to use mobile telephones, compared to BW and BRS. However, the difference was only 5% and 3%, respectively. There was no firm in BA that was using mobile telephones. Medium-sized firms were slightly more likely to adopt mobile telephones than were the small firms (3%), while micro firms were not significantly different from small and medium-sized firms. Jakarta’s firms were slightly more likely to use mobile telephones compared to those in Semarang and Denpasar (5% and 6% respectively). While Bandung showed no significant difference. The employee and innovation groups of factors indicated no significant influence on the adoption of mobile phones. On the other hand, all the factors from the ICT group of factors were significant. In line with the previous findings on the fixed-line telephones analysis (Model 8-1 to Model 8-8 on Table 8-3 and Table 8-4), firms with fixed-line telephones were less likely to use mobile telephones. Firms with computer and Internet were more likely to utilize mobile telephones.

Next, the Model 8-13 to Model 8-16 in Table 8-6 reveal the following findings. Only management personnel aged between 30 and 40 indicated a slightly greater preference for adopting mobile telephones compared with management who were under 30 years of age (1.2%). The rest of the factors for the management group factors were insignificant. The industry, employee and innovation group factors showed no significant effect. Similar to the findings for the stage 1 models, in this stage, fixed-line telephone users were the least likely to adopt mobile telephones; while computer and Internet user firms were more likely to do so.

Table 8-5 Stage 1 Result for Mobile Phone

This table shows probit regression of factors affecting the Mobile Telephone adoption (mb) on SMEs, from five factor groups: (i) management, (ii) industry, (iii) employee, (iv) innovation, and (v) Other ICT. The models are estimated per each group separately, using the following equations:

$(\boldsymbol{i})\boldsymbol{mb_i} = \boldsymbol{c} + \beta_1\boldsymbol{mg_i} + \beta_2\boldsymbol{ma_i} + \beta_3\boldsymbol{me_i}$; (ii) $\boldsymbol{mb_i} = \boldsymbol{c} + \beta_1\boldsymbol{ea_i} + \beta_2\boldsymbol{ee_i} + \beta_3\boldsymbol{eict_i}$; $\boldsymbol{mb_i} = \boldsymbol{c} + \beta_1\boldsymbol{by_i} + \beta_2\boldsymbol{bm_i} + \beta_3\boldsymbol{sc_i} + \beta_4\boldsymbol{bl_i}$; (iii) $\boldsymbol{mb_i} = \boldsymbol{c} + \beta_1\boldsymbol{by_i} + \beta_2\boldsymbol{bm_i} + \beta_3\boldsymbol{sc_i} + \beta_4\boldsymbol{bl_i}$; (iv) $\boldsymbol{mb_i} = \boldsymbol{c} + \beta_1\boldsymbol{cp_i} + \beta_2\boldsymbol{im_i} + \beta_3\boldsymbol{rd_i}$; (v) $\boldsymbol{mb_i} = \boldsymbol{c} + \beta_1\boldsymbol{com_i} + \beta_2\boldsymbol{fix_i} + \beta_3\boldsymbol{int_i} + \beta_4\boldsymbol{cc_i}$

Variable	**Model 8-9**			**Model 8-10**			**Model 8-11**			**Model 8-12**		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
i. **Management**												
Gender (male)	-0.035	0.887	-0.003	-0.035	0.887	-0.003	-0.035	0.887	-0.003	-0.035	0.887	-0.003
Management Age												
Less than 30 yrs	R	R	R	-0.273	0.323	-0.022	-0.189	0.565	-0.015	-0.178	0.730	-0.015
30-40 yrs	0.273	0.323	0.022	R	R	R	0.083	0.795	0.007	0.094	0.855	0.008
40-50 yrs	0.189	0.565	0.015	-0.083	0.795	-0.007	R	R	R	0.011	0.984	0.001
50-60 yrs	0.178	0.730	0.015	-0.094	0.855	-0.008	-0.011	0.984	-0.001	R	R	R
More than 60 yrs	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)
Management Education												
Less than HS	R	R	R	-0.401	0.156	-0.033	-0.052	0.879	-0.004	-0.052	0.879	-0.004
High School	0.401	0.156	0.033	R	R	R	0.349	0.248	0.029	0.349	0.248	0.029
Degree (University)	0.052	0.879	0.004	-0.349	0.248	-0.029	R	R	R	R	R	R
ii. **Employee**												
Age												
Less than 30 yrs	R	R	R	-0.111	0.733	-0.010						
30-40 years	-0.244	0.334	-0.020	R	R	R						
40-50 years	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)						
More than 50 yrs	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)						
Education												
Less than HS	R	R	R	-0.169	0.594	-0.015						
High School	0.371	0.229	0.031	R	R	R						
Degree (University)	-0.235	0.537	-0.019	-0.229	0.528	-0.020						
ICT level												
Low	R	R	R	-0.366	0.270	-0.032						
Medium	0.285	0.356	0.024	R	R	R						
High	-0.508	0.290	-0.042	-0.608	0.191	-0.053						

Variable	Model 8-9			Model 8-10			Model 8-11			Model 8-12		
	Coeff.	z-stat.	Marginal Effect	Coeff.	z-stat.	Marginal Effect	Coeff.	z-stat.	Marginal Effect	Coeff.	z-stat.	Marginal Effect
iii. **Industry**												
Business type												
BRT	R	R	R	-0.597	0.068	-.035*	-0.869	0.028	-.051**	-3.855	0.990	-0.218
BW	0.592	0.070	.0349037*	R	R	R	-0.272	0.451	-0.016	-3.279	0.992	-0.185
BRS	0.867	0.029	.0511099**	0.272	0.451	0.016	R	R	R	-2.997	0.992	-0.169
BA	0.000	0.000	0***	0.000	0.000	0***	0.000	0.000	0***	R	R	R
Years in Business												
More than 10 yrs	R	R	R	-0.185	0.629	-0.011	-0.137	0.756	-0.008	-0.063	0.922	-0.004
5-10 years	0.176	0.647	0.010	R	R	R	0.048	0.888	0.003	0.111	0.846	0.006
1-5 years	0.124	0.778	0.007	-0.048	0.888	-0.003	R	R	R	0.062	0.909	0.003
Less than 1 year	0.052	0.936	0.003	-0.107	0.852	-0.006	-0.059	0.913	-0.003	R	R	R
Scale												
Micro	R	R	R	-0.297	0.483	-0.017	-0.297	0.483	-0.017	0.271	0.528	0.015
Small	0.235	0.569	0.014	R	R	R	-0.595	0.082	-.0348942*	0.545	0.105	0.031
Medium	-0.344	0.418	-0.020	-0.595	0.082	-.0349*	R	R	R	R	R	R
City												
Jakarta	R	R	R	0.566	0.164	0.033	0.838	0.036	.0491631**	1.009	0.017	0.057**
Bandung	-0.590	0.144	-0.035	R	R	R	0.272	0.571	0.016	0.447	0.332	0.025
Semarang	-0.828	0.038	-.049**	-0.272	0.571	-0.016	R	R	R	0.206	0.653	0.012
Denpasar	-1.011	0.017	-.059**	-0.438	0.343	-0.026	-0.166	0.720	-0.010	R	R	R
iv. **Innovation**												
Competitor	R	R	R	-0.200	0.655	-0.017	-0.291	0.505	-0.025			
Knowledge	0.407	0.178	0.033	R	R	R	0.237	0.352	0.020			
Improvement	-0.353	0.208	-0.029	-0.153	0.521	-0.013	R	R	R			
R&D												
v. **ICT**												
Computer	R	R	R	0.461	0.209	0.033	0.907	0.025	0.036**	0.605	0.133	0.027
Fix Telephone	-1.085	0.000	-0.054***	R	R	R	-1.227	0.000	-0.049***	-1.203	0.000	-0.054***
Internet	0.465	0.088	0.023*	0.446	0.104	0.032	R	R	R	0.163	0.586	0.007
Cloud Computing	-0.176	0.537	-0.009	-0.476	0.080	-0.034*	-0.371	0.224	-0.015	R	R	R

Note: R is reference dummy variable

Table 8-6 Stage 2 Result for Mobile Phone (mb)

This table explains probit regression of factors affecting the Mobile Phone adoption (mb) on SMEs, from similar factors as in table 1. However, the models in this table are estimated in one equation for all factors:

$$\boldsymbol{mb_i} = \boldsymbol{c} + \beta_1 \boldsymbol{mg_i} + \beta_2 \boldsymbol{ma_i} + \beta_3 \boldsymbol{me_i} + \beta_5 \boldsymbol{ea_i} + \beta_6 \boldsymbol{ee_i} + \beta_7 \boldsymbol{eict_i} + \beta_8 \boldsymbol{by_i} + \beta_9 \boldsymbol{bm_i} + \beta_{10} \boldsymbol{sc_i} + \beta_{11} \boldsymbol{bl_i} + \beta_{12} \boldsymbol{cp_i} + \beta_{13} \boldsymbol{im_i} + \beta_{14} \boldsymbol{rd_i} + \beta_{15} \boldsymbol{com_i} + \beta_{16} \boldsymbol{fix_i} + \beta_{17} \boldsymbol{int_i} + \beta_{18} \boldsymbol{cc_i}$$

Variable	Model 8-13			Model 8-14			Model 8-15			Model 8-16		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
i. **Management**												
Gender (male)	0.223	0.543	0.002	0.019	0.954	0.000	-0.084	0.820	-0.001	0.097	0.797	0.001
Management Age												
30	R	R	R	-0.631	0.163	-0.013	-0.667	0.217	-0.004	0.076	0.925	0.001
30-40	1.037	0.044	0.012*	R	R	R	0.391	0.431	0.002	1.207	0.153	0.009
40-50	0.360	0.529	0.004	-0.576	0.235	-0.012	R	R	R	0.255	0.766	0.002
50-60	0.366	0.666	0.004	-0.541	0.481	-0.011	0.101	0.905	0.001	R	R	R
>60	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)
Management Education												
Less than High School	R	R	R	-0.123	0.819	-0.003	0.312	0.670	0.002	0.029	0.971	0.000
High School	0.030	0.968	0.000	R	R	R	0.237	0.645	0.001	0.445	0.419	0.003
Degree (University)	-0.325	0.706	-0.004	-0.651	0.258	-0.013	R	R	R	R	R	R
ii. **Employee**												
Age												
Less than 30 yrs	R	R	R	-0.063	0.909	-0.001	-0.131	0.808	-0.001	-0.145	0.812	-0.001
30-40 years	-0.623	0.179	-0.007	R	R	R	-0.622	0.160	-0.004	-0.532	0.262	-0.004
40-50 years	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)
More than 50 yrs	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)
Education												
Less than High School	R	R	R	-0.643	0.286	-0.013	-0.101	0.902	-0.001	0.245	0.764	0.002
High School	0.432	0.477	0.005	R	R	R	0.219	0.733	0.001	0.036	0.957	0.000
Degree (University)	0.692	0.351	0.008	0.421	0.540	0.009	R	R	R	R	R	R
ICT level												
Low	R	R	R	-0.664	0.224	-0.014	-0.299	0.680	-0.002	-0.029	0.968	0.000
Medium	0.397	0.505	0.004	R	R	R	0.604	0.327	0.004	0.728	0.249	0.005
High	-1.067	0.183	-0.012	-0.803	0.291	-0.017	R	R	R	R	R	R

Variable	Model 8-13			Model 8-14			Model 8-15			Model 8-16		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
iii. **Industry**												
Business type	R	R	R	-0.709	0.147	-0.015	-0.494	0.470	-0.003	-5.254	0.990	-0.039
BRT	0.659	0.273	0.007	R	R	R	-0.001	0.999	0.000	-4.611	0.991	-0.034
BW	0.757	0.304	0.008	0.523	0.282	0.011	R	R	R	-4.514	0.991	-0.033
BRS	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)
BA												
Years in Business	R	R	R	-0.082	0.869	-0.002	0.418	0.487	0.003	0.072	0.942	0.001
More than 10 yrs	-0.305	0.558	-0.003	R	R	R	0.310	0.572	0.002	-0.091	0.926	-0.001
5-10 years	-0.476	0.475	-0.005	0.061	0.904	0.001	R	R	R	-0.387	0.663	-0.003
1-5 years	-0.512	0.599	-0.006	-0.624	0.429	-0.013	0.048	0.952	0.000	R	R	R
Less than 1 year												
Scale	R	R	R	-0.177	0.758	-0.004	0.263	0.666	0.002	0.338	0.593	0.002
Micro	0.537	0.394	0.006	R	R	R	0.810	0.128	0.005	0.925	0.082	0.007
Small	-0.103	0.868	-0.001	-0.609	0.199	-0.013	R	R	R	R	R	R
Medium												
City	R	R	R	0.991	0.143	0.020	0.700	0.315	0.004	0.927	0.213	0.007
Jakarta	-0.647	0.334	-0.007	R	R	R	-0.701	0.496	-0.004	-0.210	0.763	-0.002
Bandung	-0.543	0.429	-0.006	0.277	0.741	0.006	R	R	R	0.283	0.778	0.002
Semarang	-0.888	0.205	-0.010	-0.365	0.577	-0.008	-0.856	0.437	-0.005	R	R	R
Denpasar												
iv. **Innovation**												
Competitor Knowledge	R	R	R	-0.090	0.900	-0.002	0.183	0.828	0.001	-0.119	0.883	-0.001
Improvement	0.455	0.434	0.005	R	R	R	0.548	0.344	0.003	0.400	0.512	0.003
R&D	-0.699	0.235	-0.008	-0.889	0.114	-0.018	R	R	R	R	R	R
v. **ICT**												
Computer	R	R	R	1.147	0.037	0.024**	1.384	0.008	0.008***	1.360	0.022	0.010**
Fix phone	-1.632	0.001	-0.018***	R	R	R	-1.649	0.001	-0.010***	-1.830	0.000	-0.014***
Mobile phone	0.727	0.076	0.008*	0.359	0.359	0.007	R	R	R	0.012	0.978	0.000
Cloud Computing	-0.077	0.862	-0.001	-0.484	0.268	-0.010	-0.684	0.146	-0.004	R	R	R

Note: R is reference dummy variable

8.4.3 Internet

Internet is one of the ICT services that is in a growing phase. Figure 6-14 in Chapter 6 shows that Internet users among SMEs reached 57.64% (230 out of 399 SMEs). This figure is much higher than the average global Internet adoption in developing countries (Table 3-3). It can be explained because the survey was done in four big cities in Indonesia. To find out the factors influencing Internet adoption by SMEs, similar data and methods used for the fixed-line and mobile telephone analysis in the previous sections are applied. In this model, Internet (int) is considered as the dependent variable. The findings are presented in Table 8-7 and Table 8-8.

In the stage 1 (Model 8-17 to Model 8-1920) presented in Table 8-7, it is interesting that younger management tend to use Internet more than the older management. Management of less than 30 years of age are significantly more likely to use Internet, 17%, 15%, 9% and 60% more than the management at the ages of 30-40 years, 40-50 years, 50-60 years, and more than 60 years old, respectively. On the other hand, the higher the management education level, the more they adopt the Internet to support their businesses. University graduate management is 28% and 19% more likely to adopt Internet than high school and high school graduates, respectively.

In terms of business type, BW is 11.8% more likely to adopt Internet than BRT. There is no significant difference that can be found in terms of the other business types. New firms are more willing to use Internet than more mature firms. The less than one year old firms are 38%, 48% and 39% more likely to adopt Internet than the 1-5 year old firms, 5-10 year old firms, and more than 10 year old firms. It is possible, therefore, that online marketing and collaboration that utilize the Internet is more efficient for new firms seeking to enter the market. Size does matter: the bigger the business size, the more Internet is used. Medium sized businesses and small businesses are 22% and 19% more likely to use Internet than micro businesses. However, there is no significant difference between the medium size and small businesses. Bandung is found to be the city with the most SMEs utilizing the Internet. Compared to Jakarta, Semarang, and Denpasar, firms in Bandung are 15%, 27% and 25% more likely to use Internet, respectively. This finding may indicate that Bandung is the city with the most creative and digital firms.

Similar to the management age factor, young employees also tend to use Internet more than older employees. Employees aged less than 30 years are 11%, 12% and 15% more likely to adopt Internet than the 30-40 year olds, 40-50 year olds and employees aged more than 50 years, respectively. The employee ICT skills factor is more significant than the employee education. The higher the employee's ICT skills, the more they are likely to adopt Internet. Employees with high ICT skills are found to be 28% and 23% more likely to use the Internet than those with low and medium level skills, while the medium level is 30% more likely than the low level.

In terms of the innovation factors, only firms with R&D indicate that they are 10% more likely to use the Internet compared to businesses with competitor knowledge. The other factors are found to be not significant in terms of decisions to adopt the Internet.

Computers are found to be the strongest factor from the ICT group of factors that influence the utilization of Internet. It accounts for 55%, 56% and 59% more than the fixed-line and mobile telephones and cloud computing. Next, Cloud Computing is also found to significantly affect the adoption of Internet, 14% more than fixed-line and mobile telephones.

The next analysis from Table 8-8 (Model 8-21 to Model 8-24) reveal the following findings. Only management aged more than 60 years is shown to be a significant factor where they're less likely to use the Internet than younger management. Therefore, it can be argued that this finding is in line with the stage 1 models, that younger management is more likely to adopt the Internet. In contrast with the stage 1 result, the models in this stage found that management education does not influence the adoption of Internet by SMEs.

From the industry factors, business type does not determine the adoption of Internet by SMEs. However, similar to the stage 1 finding, it is indicated by the business maturity factor. The new businesses tend to adopt the Internet more than more mature businesses. The small businesses are found 24% and 14% more likely to adopt Internet than the micro and medium businesses, respectively. This finding supports the stage 1 result for the small businesses compared to micro businesses, but it contradicts the findings for the small businesses compared to the medium size businesses. The model in this stage indicates that Denpasar is 19% less likely to use Internet than Jakarta, while for the rest of the cities this factor is found to be not significant.

The employee age factor in the models reveals different findings from the stage 1 models. The significant employee age is the 30-40 year group, that is found to be 14% and 11% more likely to use the Internet than the less than 30 year group and 40-50 year group. However, the employee education and ICT skill factors found similar results with the stage 1 findings. Innovation factors are found to be not significant in this stage.

The results for ICT factors in this stage support the findings in stage 1. Computers are the most important influencing factor, followed by the Cloud Computing.

Table 8-7 Stage 1 Result for Internet (int)

This table shows probit regression of factors affecting the Internet adoption (int) on SMEs, from five factor groups: (i) management, (ii) industry, (iii) employee, (iv) innovation, and (v) Other ICT. The models are estimated per each group separately, using the following equations:

$(i)\boldsymbol{int_i} = \boldsymbol{c} + \beta_1\boldsymbol{mg_i} + \beta_2\boldsymbol{ma_i} + \beta_3\boldsymbol{me_i}$; (ii) $\boldsymbol{int_i} = \boldsymbol{c} + \beta_1\boldsymbol{ea_i} + \beta_2\boldsymbol{ee_i} + \beta_3\boldsymbol{eict_i}$; $\boldsymbol{int_i} = \boldsymbol{c} + \beta_1\boldsymbol{by_i} + \beta_2\boldsymbol{bm_i} + \beta_3\boldsymbol{sc_i} + \beta_4\boldsymbol{bl_i}$; (iii) $\boldsymbol{int_i} = \boldsymbol{c} + \beta_1\boldsymbol{by_i} + \beta_2\boldsymbol{bm_i} + \beta_3\boldsymbol{sc_i} + \beta_4\boldsymbol{bl_i}$; (iv) $\boldsymbol{int_i} = \boldsymbol{c} + \beta_1\boldsymbol{cp_i} + \beta_2\boldsymbol{im_i} + \beta_3\boldsymbol{rd_i}$; (v) $\boldsymbol{int_i} = \boldsymbol{c} + \beta_1\boldsymbol{com_i} + \beta_2\boldsymbol{fix_i} + \beta_3\boldsymbol{mb_i} + \beta_4\boldsymbol{cc_i}$

Variable	Model 8-17			Model 8-18			Model 8-19			Model 8-20		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
i. **Management**												
Gender (male)	0.022	0.868	0.009	0.022	0.868	0.009	0.022	0.868	0.009	0.022	0.868	0.009
Management Age												
Less than 30 yrs	R	R	R	0.436	0.008	0.170***	0.379	0.049	0.148**	0.249	0.400	0.097
30-40 yrs	-0.436	0.008	-0.170***	R	R	R	-0.057	0.734	-0.022	-0.187	0.504	-0.073
40-50 yrs	-0.379	0.049	-0.148**	0.057	0.734	0.022	R	R	R	-0.131	0.657	-0.051
50-60 yrs	-0.249	0.400	-0.097	0.187	0.504	0.073	0.131	0.657	0.051	R	R	R
More than 60 yrs	-1.534	0.001	-0.600***	-1.098	0.018	-0.429**	-1.155	0.014	-0.452**	-1.286	0.014	-0.503**
Management Education												
Less than HS	R	R	R	-0.217	0.198	-0.085	-0.720	0.001	-0.281***	-0.720	0.001	-0.281***
High School	0.217	0.198	0.085	R	R	R	-0.503	0.008	-0.197***	-0.503	0.008	-0.197***
Degree (University)	0.720	0.001	0.281***	0.503	0.008	0.197***	R	R	R	R	R	R
ii. **Employee**												
Age												
Less than 30 yrs	R	R	R	0.289	0.082	0.113*	0.326	0.069	0.127*	0.384	0.038	0.150**
30-40 years	0.084	0.526	0.033	R	R	R	0.215	0.133	0.084	0.247	0.091	0.097*
40-50 years	-0.018	0.934	-0.007	0.125	0.575	0.049	R	R	R	0.244	0.273	0.095
More than 50 yrs	-0.138	0.750	-0.054	-0.061	0.886	-0.024	-0.030	0.943	-0.012	R	R	R
Education												
Less than High	R	R	R	0.211	0.227	0.083	0.065	0.772	0.026	0.031	0.891	0.012
School	-0.180	0.310	-0.070	R	R	R	-0.186	0.426	-0.073	-0.213	0.361	-0.083
High School	0.086	0.683	0.034	0.169	0.422	0.066	R	R	R	R	R	R
Degree (University)												
ICT level	R	R	R	-0.713	0.000	-0.279***	-0.477	0.030	-0.187**	-0.501	0.023	-0.196**
Low	0.766	0.000	0.299***	R	R	R	0.422	0.045	0.165**	0.398	0.060	0.156*
Medium	0.722	0.032	0.282**	0.593	0.073	0.232*	R	R	R	R	R	R

Variable	Model 8-17			Model 8-18			Model 8-19			Model 8-20		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
High												
iii. **Industry**												
Business type												
BRT	R	R	R	-0.310	0.082	-0.121*	-0.227	0.268	-0.088	-4.793	0.980	-1.848
BW	0.303	0.089	0.118*	R	R	R	0.083	0.609	0.032	-4.487	0.981	-1.730
BRS	0.228	0.266	0.089	-0.083	0.609	-0.032	R	R	R	-4.574	0.981	-1.764
BA	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)	0(omitted)
Years in Business												
More than 10 yrs	R	R	R	0.255	0.255	0.099	-0.015	0.951	-0.006	-1.017	0.016	-0.392**
5-10 years	-0.271	0.225	-0.106	R	R	R	-0.270	0.086	-0.105*	-1.262	0.001	-0.487***
1-5 years	-0.005	0.983	-0.002	0.270	0.086	0.105*	R	R	R	-0.992	0.007	-0.383***
Less than 1 year	0.965	0.021	0.376**	1.262	0.001	0.491***	0.992	0.007	0.386***	R	R	R
Scale												
Micro	R	R	R	-0.568	0.015	-0.221**	-0.568	0.015	-0.221**	-0.660	0.012	-0.254**
Small	0.499	0.029	0.194**	R	R	R	R	R	R	-0.097	0.557	-0.038
Medium	0.579	0.025	0.225**	0.073	0.661	0.028	0.073	0.661	0.028	R	R	R
City												
Jakarta	R	R	R	-0.404	0.055	-0.157*	0.293	0.202	0.114	0.231	0.314	0.089
Bandung	0.373	0.073	0.145*	R	R	R	0.697	0.012	0.271**	0.642	0.016	0.247**
Semarang	-0.279	0.223	-0.109	-0.697	0.012	-0.271**	0.055	0.845	0.021	-0.054	0.846	-0.021
Denpasar	-0.246	0.282	-0.096	-0.643	0.016	-0.250**	R	R	R	R	R	R
iv. **Innovation**												
Competitor Knowledge	R	R	R	-0.195	0.367	-0.076	-0.137	0.517	-0.054			
Improvement	0.030	0.855	0.012	R	R	R	0.166	0.266	0.065			
R&D	0.223	0.115	0.087	0.261	0.043	0.102**	R	R	R			
v. **ICT**												
Computer	R	R	R	1.454	0.000	0.556***	1.480	0.000	0.565***	1.552	0.000	0.594***
Fix Telephone	-0.141	0.359	-0.055	R	R	R	-0.239	0.137	-0.091	-0.155	0.345	-0.059
Mobile phone	0.756	0.033	0.295**	0.578	0.111	0.221	R	R	R	0.444	0.230	0.170
Cloud Computing	0.732	0.000	0.286***	0.369	0.030	0.141**	0.377	0.027	0.144**	R	R	R

Note: R is reference dummy variable

Table 8-8 Stage 2 Result for Internet (int)

This table explains probit regression of factors affecting the Internet adoption (int) on SMEs, from similar factors as in table 1. However, the models in this table are estimated in one equation for all factors:

$$\boldsymbol{int_i} = \boldsymbol{c} + \beta_1 \boldsymbol{mg_i} + \beta_2 \boldsymbol{ma_i} + \beta_3 \boldsymbol{me_i} + \beta_5 \boldsymbol{ea_i} + \beta_6 \boldsymbol{ee_i} + \beta_7 \boldsymbol{eict_i} + \beta_8 \boldsymbol{by_i} + \beta_9 \boldsymbol{bm_i} + \beta_{10} \boldsymbol{sc_i} + \beta_{11} \boldsymbol{bl_i} + \beta_{12} \boldsymbol{cp_i} + \beta_{13} \boldsymbol{im_i} + \beta_{14} \boldsymbol{rd_i} + \beta_{15} \boldsymbol{com_i} + \beta_{16} \boldsymbol{fix_i} + \beta_{17} \boldsymbol{mb_i} + \beta_{18} \boldsymbol{cc_i}$$

Variable	Model 8-21			Model 8-22			Model 8-23			Model 8-24		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
i. **Management**												
Gender (male)	-0.101	0.518	-0.039	-0.018	0.913	-0.007	-0.026	0.872	-0.010	-0.009	0.953	-0.004
Management Age												
30	R	R	R	0.073	0.740	0.027	0.049	0.842	0.018	0.094	0.806	0.035
30-40	-0.314	0.140	-0.121	R	R	R	-0.101	0.612	-0.038	-0.137	0.700	-0.051
40-50	-0.315	0.205	-0.121	0.000	0.998	0.000	R	R	R	-0.164	0.641	-0.061
50-60	-0.174	0.646	-0.067	0.043	0.909	0.016	0.023	0.951	0.009	R	R	R
>60	-2.518	0.001	-.967***	-2.354	0.003	-.885***	-2.343	0.001	-.879***	-2.539	0.001	-.946*
Management Education												
Less than High School	R	R	R	-0.051	0.851	-0.019	-0.151	0.690	-0.057	-0.244	0.512	-0.091
High School	-0.023	0.933	-0.009	R	R	R	-0.163	0.525	-0.061	-0.198	0.429	-0.074
Degree (University)	0.517	0.161	0.199	0.310	0.303	0.117	R	R	R	R	R	R
ii. **Employee**												
Age												
Less than 30 yrs	R	R	R	0.027	0.901	0.010	-0.031	0.892	-0.012	0.162	0.481	0.060
30-40 years	0.362	0.042	.1390378**	R	R	R	0.219	0.236	0.082	0.311	0.099	0.116*
40-50 years	0.429	0.153	0.165	0.466	0.116	0.175	R	R	R	R	R	R
More than 50 yrs	0.178	0.735	0.069	-0.052	0.925	-0.020	0.068	0.904	0.026	0.559	0.053	0.208*
Education												
Less than High School	R	R	R	0.365	0.193	0.137	0.191	0.538	0.072	0.108	0.712	0.040
High School	-0.448	0.100	-0.172	R	R	R	-0.239	0.435	-0.090	-0.217	0.474	-0.081
Degree (University)	-0.451	0.146	-0.173	-0.066	0.845	-0.025	R	R	R	R	R	R
ICT level												
Low	R	R	R	-0.688	0.003	-0.259***	-0.126	0.659	-0.047	-0.171	0.540	-0.064
Medium	1.029	0.000	0.395***	R	R	R	0.788	0.003	0.296***	0.619	0.017	0.231**
High	1.325	0.007	0.509***	0.658	0.210	0.248	R	R	R	R	R	R

Variable	Model 8-21			Model 8-22			Model 8-23			Model 8-24		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
iii. **Industry**												
Business type	R	R	R	-0.256	0.222	-0.096	-0.190	0.480	-0.071	-4.316	0.981	-1.608
BRT	0.146	0.474	0.056	R	R	R	0.046	0.832	0.017	-4.103	0.982	-1.529
BW	0.187	0.487	0.072	0.040	0.852	0.015	R	R	R	-4.118	0.982	-1.535
BRS	0.000	0.000	0***	0.000	0.000	0***	0.000	0.000	0***	R	R	R
BA												
Years in Business	R	R	R	0.251	0.362	0.095	-0.079	0.805	-0.030	-0.777	0.133	-0.290
More than 10 yrs	-0.368	0.159	-0.141	R	R	R	-0.354	0.071	-.1328416*	-1.063	0.021	-0.396
5-10 years	-0.011	0.971	-0.004	0.360	0.069	.1352583*	R	R	R	-0.850	0.055	-0.317
1-5 years	1.260	0.010	.4840705***	1.288	0.005	.4843739***	0.880	0.044	.3304153**	R	R	R
Less than 1 year												
Scale	R	R	R	-0.505	0.071	-.1899616*	-0.195	0.544	-0.073	-0.279	0.381	-0.104
Micro	0.625	0.018	.2400764**	R	R	R	0.393	0.066	.1473868*	0.317	0.133	0.118
Small	0.508	0.104	0.195	-0.313	0.164	-0.118	R	R	R	R	R	R
Medium												
City	R	R	R	0.226	0.426	0.085	-0.160	0.611	-0.060	0.353	0.237	0.132
Jakarta	0.139	0.595	0.053	R	R	R	-0.310	0.449	-0.117	0.110	0.742	0.041
Bandung	0.012	0.968	0.005	0.373	0.357	0.140	R	R	R	0.353	0.388	0.132
Semarang	-0.516	0.085	-.1981675*	-0.108	0.752	-0.041	-0.572	0.183	-0.215	R	R	R
Denpasar												
iv. **Innovation**												
Competitor Knowledge	R	R	R	-0.126	0.649	-0.047	-0.196	0.473	-0.074	-0.103	0.701	-0.038
Improvement	-0.123	0.548	-0.047	R	R	R	0.049	0.820	0.018	0.057	0.790	0.021
R&D	0.026	0.911	0.010	-0.152	0.564	-0.057	R	R	R	R	R	R
v. **ICT**												
Computer	R	R	R	1.450	0.000	0.546***	1.502	0.000	0.564***	1.596	0.000	0.595***
Fix phone	-0.017	0.927	-0.007	R	R	R	-0.158	0.432	-0.059	-0.134	0.507	-0.050
Mobile phone	1.020	0.012	0.392**	0.635	0.121	0.239	R	R	R	0.360	0.371	0.134
Cloud Computing	0.899	0.000	0.346***	0.588	0.005	0.221***	0.699	0.001	0.262***	R	R	R

Note: R is reference dummy variable

8.5 Factors Affecting Cloud Computing Adoption

Research found in the literature suggests that Cloud Computing services are a natural fit for SMEs (Dachyar and Prasetya, 2012, Surendro and Fardani, 2014, Ross and Blumenstein, 2014). Cloud Computing offers the opportunity for SMEs to grow their business both locally and internationally. However, from the previous findings in Chapter 5 that also confirm the previous studies, Cloud Computing has not played a significant role in boosting SME output (Mohabbattalab et al., 2014; Mohlameane and Ruxwana, 2014; Ross and Blumenstein, 2015; Khan and Al-Yasiri, 2015). On the other hand, previous studies found that SMEs are ready to adopt Cloud Computing (Erisman, 2013; ProQuest, 2016).

The objective of this study is to investigate the factors affecting Cloud Computing adoption by SMEs, employing the primary data. The analysis considers five groups of factors: (1) management factors, (2) business factors, (3) innovation factors, (4) employee factors, and (5) ICT factors. Management factors include gender, age, education, and job title of the management. The data for management variables are represented by the respondents who filled in the questionnaires. Meanwhile, business factors cover industry, business, business scale, product or service, and years in business. Continuous improvement, R&D, and knowledge of competitors are grouped together as innovation factors. Employee factors are employee age, employee education and employee ITC literacy. The group of ICTS usage consists of computer, fixed-line telephones, mobile telephones, and Internet.

8.6 Results and Analysis

Table 8-9 explains the empirical results from the models in stage one, Model 8-25 to Model 8-278. In Model 8-25, the reference variables are the first variable per each sub group factor. For instance, in management factors they are less than 30 years old for management age, and less than high school level for management education. The next variables chosen were the reference variables for the next model. The results of Model 8-25 to Model 8-278 show that management gender is not a significant factor in determining the adoption of Cloud Computing in Indonesian SMEs. Management in this study are the owner, CEO, CIO, CFO, or manager level. Older management (aged 50-60 years old) are more willing to use Cloud Computing than younger management. Management with higher education levels are significantly more likely to use Cloud Computing. Management with university degrees and high school education are 36.3% and 22.2%, respectively, more likely to use Cloud Computing than management with less than high school level education. Meanwhile, compared to high school education, management with university degrees are 14% more willing to adopt Cloud Computing.

Cloud Computing adoption was found to be not determined by the business type. Whether businesses are retailers, wholesalers, resellers or assemble products, it does not affect Cloud Computing adoption. In terms of maturity, the more mature firms are, the more they utilize Cloud Computing. Firms with more than 10 years and 5 to 10 years of operation in their industry are 39.7% and 33.4%, respectively, more likely to adopt Cloud Computing than a newly established firm (less than 1 year in their industry). Meanwhile, compared to businesses with 1-5 years in their industry, the more mature businesses are more than 20% more likely to have adopted Cloud Computing.

Cloud Computing adoption is also determined by business scale and location. Bigger scale firms use Cloud Computing more than smaller scale firms. Cloud Computing use in micro and small SMEs is 23.7% and 12.5% less than in medium SMEs, respectively. SMEs in Semarang have adopted Cloud Computing less than those in other cities. Compared to Semarang, SMEs in Jakarta, Bandung and Denpasar are 44.1%, 56.8% and 55.4% more likely to be using Cloud Computing, respectively. There is no differentiation between SMEs in Jakarta and Denpasar, nor is there between SMEs in Bandung and Denpasar. However, Jakarta's SMEs are 39.4% less likely than Bandung's SMEs to have adopted Cloud Computing.

In contrast to the management factors, firms with younger employees are more likely to utilize Cloud Computing. Businesses with employees less than 30 years old are 20% more likely to use Cloud Computing than firms with older employees. The employee education factor shows a similar result to the management education factor. Firms with employees who have graduated from high school and university tend to use Cloud Computing. However, the adoption of Cloud Computing in firms with employees who have high school education are 26.2% more likely than firms with employees who have university degrees. Employees having high level ICT competency significantly affects the adoption of Cloud Computing. It is 26.3% and 26.8% more likely compared to medium and low level ICT competency, respectively. However, there is no difference between businesses with employees who have medium and low level ICT competency.

Compared to competitor knowledge, firms that conduct continuous improvement and R&D are more likely to use Cloud Computing.

The usage of computer, fixed-line telephones and Internet are the significant factors that affect Cloud Computing adoption in Indonesia’s SMEs, based on models in stage 1.

The following discussion explains the empirical results from stage 2 models:Model 8-29 to Model 8-32. The results are presented in Table 8-10.

None of the management factors are significant in determining the adoption of Cloud Computing in Indonesia’s SMEs. This finding is not in line with the result from stage 1, where age and education affect Cloud Computing adoption.

Aside from business scale, the results for the other industry factors are consistent with the stage 1 result. The business type and scale are not significant in model Model 8-29 to Model 8-32. Firms that have operated for more than 5 years in their industry are almost 45% more likely to adopt Cloud Computing than less mature firms. Businesses located in Semarang are the least likely to adopt Cloud Computing.

Results relating to the employee factors are similar with stage 1 results. Less than 30 year old employees are more willing to adopt Cloud Computing than older employee age groups. Employees with high school are more likely to determine adoption than other education levels of the employees. Only businesses that have employees with a high level of ICT skills are found to affect the adoption of ICT.

The results from innovation factors are slightly different from the stage 1 findings. Similar to the stage 1 result, competitor knowledge does not affect the Cloud Computing adoption, while continuous improvement is only significant when compared with R&D. Businesses that conduct consistent R&D need more Cloud Computing than firms which are only conducting continuous improvement and know their competitors.

As indicated in the stage 1 models, the use of mobile phones does not determine the adoption of Cloud Computing, while use of computers and the Internet do. In contrast with the previous stage finding, fixed-line telephones are not significant in this stage.

Table 8-9 Stage 1 Result

This table shows probit regression of factors affecting the Internet adoption (int) on SMEs, from five factor groups: (i) management, (ii) industry, (iii) employee, (iv) innovation, and (v) Other ICT. The models are estimated per each group separately, using the following equations:

$(\boldsymbol{i})\boldsymbol{cc_i} = \boldsymbol{c} + \beta_1 \boldsymbol{mg_i} + \beta_2 \boldsymbol{ma_i} + \beta_3 \boldsymbol{me_i}$; (ii) $\boldsymbol{cc_i} = \boldsymbol{c} + \beta_1 \boldsymbol{ea_i} + \beta_2 \boldsymbol{ee_i} + \beta_3 \boldsymbol{eict_i}$; $\boldsymbol{cc_i} = \boldsymbol{c} + \beta_1 \boldsymbol{by_i} + \beta_2 \boldsymbol{bm_i} + \beta_3 \boldsymbol{sc_i} + \beta_4 \boldsymbol{bl_i}$; (iii) $\boldsymbol{cc_i} = \boldsymbol{c} + \beta_1 \boldsymbol{by_i} + \beta_2 \boldsymbol{bm_i} + \beta_3 \boldsymbol{sc_i} + \beta_4 \boldsymbol{bl_i}$; (iv) $\boldsymbol{cc_i} = \boldsymbol{c} + \beta_1 \boldsymbol{cp_i} + \beta_2 \boldsymbol{im_i} + \beta_3 \boldsymbol{rd_i}$; (v) $\boldsymbol{cc_i} = \boldsymbol{c} + \beta_1 \boldsymbol{com_i} + \beta_2 \boldsymbol{fix_i} + \beta_3 \boldsymbol{mb_i} + \beta_4 \boldsymbol{int_i}$

Variable	Model 8-25			Model 8-26			Model 8-27			Model 8-28		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
vi. **Management**												
Gender (male)	-0.113	0.434	-0.037	-0.113	0.434	0.037	-0.113	0.434	0.037	-0.113	0.434	0.037
Management Age												
Less than 30 yrs	R	R	R	0.138	0.436	0.045	-0.019	0.922	-0.006	-0.165	0.695	-0.054
30-40 yrs	-0.138	0.436	-0.045	R	R	R	-0.157	0.381	-0.051	-0.303	0.463	-0.099
40-50 yrs	0.019	0.922	0.006	0.157	0.381	0.051	R	R	R	-0.145	0.731	0.127
50-60 yrs	0.554	0.060*	0.181*	0.693	0.014**	0.226**	0.535	0.070*	0.174*	0.389	0.411	0.047
More than 60 yrs	0.165	0.695	0.055	0.303	0.463	0.099	0.145	0.731	0.0467	R	R	R
Management Education												
Less than High School	R	R	R	-.680	0.002***	-0.222***	-1.111	0.000***	-0.363***	-1.111	0.000***	-0.363***
High School	0.680	0.002***	0.222***	R	R	R	-0.431	0.015**	-0.140**	-0.431	0.015**	-0.140**
Degree (University)	1.111	0.000***	0.363***	0.431	0.015**	0.140**	R	R	R	R	R	R
vii. **Employee**												
Age												
Less than 30 yrs	R	R	R	0.836	0.000	0.269***	0.757	0.000	0.242***	0.835	0.000	0.266***
30-40 years	-0.100	0.491	-0.032	R	R	R	0.118	0.427	0.038	0.159	0.291	0.051
40-50 years	0.073	0.753	0.024	0.349	0.149	0.112	R	R	R	0.564	0.017	0.180**
More than 50 yrs	0.380	0.381	0.123	0.735	0.100	0.236*	0.682	0.116	0.218	R	R	R
Education												
Less than High School	R	R	R	-0.476	0.015	-0.153**	-0.069	0.769	-0.022	-0.073	0.756	-0.023
High School	0.851	0.000	0.276***	R	R	R	0.820	0.002	0.262***	0.816	0.002	0.260***
Degree (University)	0.374	0.074	0.121*	0.216	0.290	0.069	R	R	R	R	R	R
ICT level												
Low	R	R	R	-0.015	0.939	-0.005	-0.149	0.527	-0.048	-0.218	0.358	-0.070
Medium	-0.015	0.935	-0.005	R	R	R	-0.214	0.349	-0.068	-0.258	0.261	-0.082
High	0.812	0.007	0.263***	0.896	0.003	0.288***	R	R	R	R	R	R

Variable	Model 8-25			Model 8-26			Model 8-27			Model 8-28		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
viii. **Industry**												
Business type												
BRT	R	R	R	-0.004	0.985	-0.001	0.123	0.591	0.038	-.409	0.608	-0.127
BW	0.000	0.998	0.000	R	R	R	0.120	0.475	0.037	-.408	0.601	-0.127
BRS	-0.105	0.647	-0.032	-.113	0.500	-0.352	R	R	R	-.514	0.511	-0.160
BA	0.409	0.608	0.127	0.374	0.634	0.116	0.501	0.525	0.155	R	R	R
Years in Business												
More than 10 yrs	R	R	R	0.188	0.417	0.058	0.864	0.001***	0.267***	1.276	0.004***	0.397***
5-10 years	-0.200	0.386	-0.062	R	R	R	0.704	0.000***	0.217***	1.075	0.008***	0.334***
1-5 years	-0.908	0.000***	-0.282***	-0.702	0.000***	-0.217***	R	R	R	0.368	0.361	0.114
Less than 1 year	-1.276	0.004***	-0.397***	-1.039	0.011**	-0.322**	-0.343	0.396	-0.105	R	R	R
Scale												
Micro	R	R	R	-0.377	0.146	-0.377	-0.768	0.007***	-0.237***	R	R	R
Small	0.230	0.356	0.717	R	R	R	-0.404	0.018**	-0.125**	0.230	0.356	0.717
Medium	0.597	0.030**	0.185**	0.350	0.042**	0.350**	R	R	R	0.597	0.030**	0.185**
City												
Jakarta	R	R	R	-.394	0.069*	-0.394*	1.428	0.000***	0.441***	-0.338	0.149	-0.105
Bandung	0.338	0.115	0.105	R	R	R	1.838	0.000***	0.568***	0.000	0.998	0.000
Semarang	-1.386	0.000***	-0.431***	-1.806	0.000***	-1.806***	R	R	R	-1.724	0.000***	-0.536***
Denpasar	0.338	0.149	0.105	-.0483	0.857	-0.0483	1.792	0.000***	0.554***	R	R	R
ix. **Innovation**												
Competitor Knowledge	R	R	R	-0.112	0.642	-0.037	-0.071	0.762	-0.023			
Improvement	0.535	0.009	0.174***	R	R	R	0.784	0.000	0.257***			
R&D	0.487	0.002	0.158***	0.675	0.000	0.222***	R	R	R			
x. **ICT**												
Computer	R	R	R	0.720	0.000	0.234***	0.672	0.000	0.218***	0.863	0.000	.281***
Fix phone	0.483	0.002	0.157***	R	R	R	0.464	0.003	0.150***	0.398	0.012	.130**
Mobile phone	-0.239	0.491	-0.078	-0.574	0.095	-0.186*	R	R	R	-0.271	0.441	-0.088
Internet	0.703	0.000	0.229***	0.365	0.026	0.119**	0.386	0.020	0.125**	R	R	R

Note: R is reference dummy variable

Table 8-10 Stage 2 Result

This table explains probit regression of factors affecting the Cloud Computing adoption (cc) on SMEs, from similar factors as in table 7. However, the models in this table are estimated in one equation for all factors:

$$\boldsymbol{cc_i = c +} \ \beta_1 \boldsymbol{mg_i} + \beta_2 \boldsymbol{ma_i} + \beta_3 \boldsymbol{me_i} + \beta_5 \boldsymbol{ea_i} + \beta_6 \boldsymbol{ee_i} + \beta_7 \boldsymbol{eict_i} + \beta_8 \boldsymbol{by_i} + \beta_9 \boldsymbol{bm_i} + \beta_{10} \boldsymbol{sc_i} + \beta_{11} \boldsymbol{bl_i} + \beta_{12} \boldsymbol{cp_i} + \beta_{13} \boldsymbol{im_i} + \beta_{14} \boldsymbol{rd_i} + \beta_{15} \boldsymbol{com_i} + \beta_{16} \boldsymbol{fix_i} + \beta_{17} \boldsymbol{mb_i} + \beta_{18} \boldsymbol{int_i}$$

Variable	**Model 8-29**			**Model 8-30**			**Model 8-31**			**Model 8-32**		
	Coeff.	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**	**Coeff.**	**z-stat.**	**Marginal Effect**
i. Management												
Gender (male)	0.088	0.618	0.024	0.061	0.739	0.017	0.042	0.809	0.012	0.043	0.806	0.012
Management Age												
30	R	R	R	0.092	0.693	0.025	0.049	0.849	0.013	-0.176	0.645	-0.049
30-40	-0.261	0.262	-0.072	R	R	R	-0.083	0.702	-0.022	-0.349	0.328	-0.098
40-50	-0.173	0.513	-0.048	-0.059	0.794	-0.016	R	R	R	-0.312	0.378	-0.087
50-60	0.081	0.835	0.022	0.180	0.628	0.049	0.328	0.366	0.090	R	R	R
>60	-0.145	0.784	-0.040	-0.112	0.836	-0.031	0.016	0.975	0.004	-0.627	0.283	-0.175
Management Education												
Less than High School	R	R	R	-0.152	0.642	-0.042	-0.317	0.408	-0.086	-0.372	0.325	-0.104
High School	-0.159	0.640	-0.044	R	R	R	-0.305	0.166	-0.083	-0.330	0.128	-0.092
Degree (University)	0.303	0.436	0.084	0.358	0.141	0.098	R	R	R	R	R	R
ii. Employee												
Age												
Less than 30 yrs	R	R	R	0.682	0.015	0.187**	0.579	0.035	0.158**	0.566	0.037	0.158**
30-40 years	-0.044	0.824	-0.012	R	R	R	0.037	0.846	0.010	0.099	0.603	0.028
40-50 years	0.006	0.983	0.002	0.316	0.326	0.086	R	R	R	0.421	0.157	0.118
More than 50 yrs	0.166	0.734	0.046	0.322	0.530	0.088	0.248	0.610	0.068	R	R	R
Education												
Less than High School	R	R	R	-0.319	0.256	-0.087	0.081	0.791	0.022	0.159	0.587	0.044
High School	0.768	0.019	0.213**	R	R	R	0.839	0.017	0.229**	0.826	0.019	0.231**
Degree (University)	-0.023	0.935	-0.006	-0.139	0.605	-0.038	R	R	R	R	R	R
ICT level												
Low	R	R	R	0.296	0.270	0.081	-0.015	0.959	-0.004	-0.090	0.755	-0.025
Medium	-0.298	0.219	-0.082	R	R	R	-0.524	0.054	-0.143*	-0.456	0.091	-0.127*
High	1.038	0.005	0.287***	1.061	0.006	0.290***	R	R	R	R	R	R

Variable	Model 8-29			Model 8-30			Model 8-31			Model 8-32		
	Coeff.	z-stat.	Marginal Effect	Coeff.	z-stat.	Marginal Effect	Coeff.	z-stat.	Marginal Effect	Coeff.	z-stat.	Marginal Effect
iii. Industry												
Business type	R	R	R	0.361	0.174	0.099	0.263	0.358	0.072	0.393	0.635	0.110
BRT	-0.388	0.141	-0.107	R	R	R	0.110	0.596	0.030	0.273	0.734	0.076
BW	-0.491	0.102	-0.136	-0.170	0.400	-0.046	R	R	R	0.210	0.796	0.059
BRS	-0.363	0.670	-0.101	0.023	0.977	0.006	-0.313	0.697	-0.085	R	R	R
BA												
Years in Business	R	R	R	0.035	0.897	0.010	0.885	0.003	0.241***	1.603	0.002	0.448***
More than 10 yrs	-0.052	0.843	-0.014	R	R	R	0.849	0.000	0.231***	1.602	0.001	0.448***
5-10 years	-1.041	0.001	-0.288***	-1.104	0.000	-0.302***	R	R	R	0.814	0.073	0.227*
1-5 years	-1.808	0.001	-0.500***	-1.848	0.000	-0.506***	-0.845	0.061	-0.230*	R	R	R
Less than 1 year												
Scale	R	R	R	-0.166	0.572	-0.045	0.007	0.984	0.002	0.033	0.921	0.009
Micro	0.060	0.834	0.016	R	R	R	0.030	0.883	0.008	0.094	0.651	0.026
Small	-0.023	0.945	-0.006	-0.154	0.470	-0.042	R	R	R	R	R	R
Medium												
City	R	R	R	0.343	0.218	0.094	1.316	0.010	0.359***	-0.116	0.691	-0.032
Jakarta	-0.265	0.332	-0.073	R	R	R	1.151	0.038	0.314**	-0.387	0.236	-0.108
Bandung	-1.365	0.005	-0.378***	-1.165	0.037	-0.319**	R	R	R	-1.343	0.015	-0.375**
Semarang	-0.104	0.727	-0.029	0.367	0.267	0.100	1.491	0.007	0.406***	R	R	R
Denpasar												
iv. Innovation												
Competitor Knowledge	R	R	R	0.313	0.335	0.086	0.044	0.884	0.012	0.098	0.749	0.027
Improvement	0.421	0.114	0.117	R	R	R	0.415	0.133	0.113	0.486	0.075	0.136*
R&D	0.454	0.072	0.126*	0.441	0.098	0.120*	R	R	R	R	R	R
v. ICT												
Computer	R	R	R	0.613	0.003	0.168***	0.655	0.002	0.179***	0.966	0.000	0.270***
Fix phone	0.288	0.162	0.080	R	R	R	0.242	0.253	0.066	0.177	0.393	0.049
Mobile phone	-0.285	0.507	-0.079	-0.376	0.395	-0.103	R	R	R	-0.443	0.322	-0.124
Internet	0.852	0.000	0.236***	0.638	0.002	0.175***	0.646	0.001	0.176***	R	R	R

Note: R is reference dummy variable

8.7 Summary

Management, employees, industry, innovation, and ICT are the significant factors affecting the decision to adopt ICT services on SMEs. This analysis involved the primary data described in Chapter 6. It combined the TAM and TOE frameworks and applied a binary choice probit model. The findings on the factors affecting the adoption of fixed-line telephones, mobile telephones, Internet, and Cloud Computing, are provided in this chapter. The key findings provided in this chapter answer Q4.

The first finding indicates that the following factors are significantly more likely to lead to the use of fixed-line telephones than other factors: (1) middle aged management (30-40 years old), (2) assembly base firm (BA), (3) more mature firms, (4) larger firm size, (5) location in Denpasar, (6) higher education level, (7) lower ICT skills, (8) competitor knowledge. While these two factors are less likely to lead to the use of fixed-line telephones compared to others: (1) firms located in Jakarta, and (2) firms that use mobile telephones.

Second, for the mobile telephones, the factors that are shown to be significant only indicate a slight difference compared to the other factors. However, it is interesting to note that the firms using fixed-line telephones are also less likely to use mobile telephones. This finding is in line with the finding in the fixed telephones analysis.

Third, the factors that affect the adoption of the Internet are: (1) younger management age, (2) new comer firms, (3) small size firms, (4) higher employee ICT skills, (5) computer, and (6) Cloud Computing.

Next, the following findings identify outcomes related to Cloud Computing adoption by Indonesian SMEs, in response to Q5. The Cloud Computing implementation by SMEs is more likely to be determined by the employee factors than the management ones. This study confirms that firms with young employees, high school employee education and employees with a high level of ICT competency are more likely to adopt Cloud Computing. This finding strongly supports a previous study that indicate employee education level determines the adoption of ICT by SMEs (Luchetti and Sterlacchini, 2004).

Furthermore, mature SMEs that have been in industry for more than 5 years need Cloud Computing more than new SMEs. While SMEs located in Semarang, the city with medium economic growth, are the least likely to adopt Cloud Computing. The adoption of Cloud Computing is not affected by other industry factors, such as the business type and scale. This finding contradicts previous studies that found that the Cloud Computing penetration in SMEs depends on the firm size (Low at al., 2011; Alshamila et al., 2013; Olivera et al., 2014).

The innovation factor that improves likelihood of Cloud Computing being adopted is R&D. Competitor knowledge was found to be not relevant with the decision to use Cloud Computing. This finding supports a previous study that found Cloud Computing provides opportunities for product innovation (Ross and Blumenstein, 2014).

Other ICT which affects the use of Cloud Computing are computers and the Internet. Mobile telephone is used by the vast majority of SMEs (95.99%), however, it is not significant with the Cloud Computing adoption.

Chapter 9 provides linkages between the findings in Chapters 4,5 and 7 and this Chapter, as the conclusion of this study.

Chapter 9 Summary and Conclusion

9.1 Introduction

This chapter summarises the key results and provides policy implications derived from the previous chapters. This chapter is organized in the following manner. Section 9.2 presents the main contributions of the study. In Section 9.3, the linkages between the key findings are discussed. Sections 9.4 and 9.5 address the practical implications and limitations of the current study, respectively.

9.2 Research Contributions

The aggregate production function is a simplification of complex production processes in various forms. It was developed based on the Solow Growth Model (Solow, 1957) to explain the relationship between the inputs and outputs of the whole economy. The Cobb-Douglas (1930) production function is the most popular framework used by researchers to examine the influence of technology on the output.

ICT has been used in the studies to represent technology because of the rapid increase of ICT usage to support business operations and people's daily activities. Therefore, many studies have examined ICT as a growth-promoting factor, not only at the firm level, but also at the country level and for the purpose of comparing countries. Numerous such studies applied the Cobb-Douglass production function framework (Ilmakunnas and Miyakoshi, 2013; Ceccobelli et al., 2012; Samoilenko and Osei-Bryson, 2008; Vicenzi, 2012; Dimelis and Papaioannou, 2012). However, since the ICT delivery model has changed from an in-house service model to an outsourced service model, only a limited number of studies have focused on ICT as an outsourced service (ICT services) model.

In addition, the influence of ICT services on economic growth as a result of their utilization by SMEs remains unclear. Considering SMEs as the major economic player, and the significant role of ICT as the growth enhancing factor, it is important to investigate the contribution of ICT services to increasing SME output that eventually improves the countries' economy. This study provides a global overview as well as empirical evidence from Indonesia, one of the emerging economies. This study developed the models by applying a panel estimation method, an econometric technique that was best suited for the dynamic changes effect, such as technology (Gujarati, 2003).

Further, this study examined the significant factors influencing the adoption of ICT services by SMEs. The analysis combined two technology adoption frameworks: TAM from the individual perspective and TOE from the firm's perspective (Davies, 1989; Tornatzky and Fleischer, 1990). The analysis covered the following group factors: management factor, employee factor, industry factor, innovation factor and other ICT factors. A binary probit choice model was applied to develop the models. This method is relevant as it can predict the value of an outcome variable from the explanatory variables. Therefore, it is commonly used to investigate the adoption factors (Youssef et al., 2011; Medonka et al., 2015).

Two research methods have been applied in this study. The first is the primary data analysis, used to examine the impact of ICT services on Indonesian SMEs, and the adoption of ICT services, specifically cloud computing. The second method involved the analysis of secondary data, conducted to determine the role that ICT services played in the economic growth from the global perspective and in the Indonesian context. Additionally, it was used to examine the influence of SMEs on Indonesia's economy. The key contributions of this study are as follows.

Firstly, the ICT trend, previous studies of the influence of ICT on economic growth, and the challenges of SMEs in adopting the ICT were comprehensively reviewed in Chapter 2.

Over the past two decades, the ICT delivery model has evolved from the traditional in-house ICT to include outsourced ICT services (Lucchetti and Sterlacchini, 2004; Djiofack-Zebaze and Keck, 2009, Turen et al., 2016). The most basic outsourced ICT service model includes fixed-line telephones, mobile telephones, and Internet services, while a more recent outsourced ICT service model has expanded to include Cloud Computing. The literature reveals that the penetration of ICT is increasing rapidly. In spite of this, there are significant differences between the developed and developing countries regarding the utilisation of ICT services between the developed and developing countries. The use of mobile telephone was increasing more rapidly in developing countries than in developed countries (James, 2011; Howard, 2009; ITU, 2016). Meanwhile, Internet penetration in 2015 was 78.1% and 36.7% for developed and developing countries, respectively (ITU, 2016). In 2016, the fixed and mobile broadband penetration per 100 inhabitants in developed countries reached 60.2%, while in developing countries it was 24.6% (ITU, 2016). In-line with the increase in ICT utilisation by business, Government and individuals, empirical evidence implies that ICT plays an important role in economic growth (Jorgenson and Stiroh, 1999; Thompson Jr. and Garbacz, 2007; Samoilenko and Osei-Bryson, 2008; Djiofack-Zebaze and Keck, 2009; Ketteni et al., 2011; Lee et al., 2011; Colombo et al., 2013; Forero, 2013; Dedrick et al., 2013). However, these studies consider ICT mainly in the context of an in-house ICT delivery model. On the other hand, SMEs as the major economic player face challenges reagrding the adoption of ICT services. Nevertheless, researchers and service providers have suggested that ICT is one of the key growth engines for SMEs, it facilitates the SME business operations (Colombo et al, 2013; Santosa and Kusumawardani, 2010; Tutunea, 2014). Despite this, there is a dearth of studies on the impact of ICT services on SMEs as a means of growing the national economy.

Secondly, the secondary data analysis method and the secondary data used in this study are discussed in Chapter 3. For this analysis, a panel regression analysis has been used to identify the effect of ICT services on economic growth as a global trend, and the relationships between ICT services and other economic growth variables. This analysis, presented in Chapter 4, answered Q1 and Q2. This research contributes to knowledge by introducing ICT services as a new explanatory variable in the model. In addition, a cross country analysis was carried out to compare the influence of ICT services on economic growth in developed and developing countries. In addition, to the best of our knowledge, previous studies have not conducted a cross-country analysis to compare the influence of ICT services on the economic growth in developed and developing countries. Panel data sets from 28 developed countries and 15 developing countries over the period from 1970 to 2013 were gathered from various sources, such as the World Bank database, the IMF database, the ILO database and the ITU database. The data was examined considering the Indonesia context of the ICT services role on national economic growth. In the meantime, the secondary data series over the period 2003 to 2013 has been obtained from the Indonesian MCSME and the Central Statistical Bureau (Biro Pusat Statistik / BPS) of Indonesia. The data was used to investigate the impact of SMEs on Indonesia's economy. The findings of the Indonesia context secondary data analysis were provided in Chapter 5.

Thirdly, the literature review in Chapter 2 reveals that there are contrasting evidence relating to the ICT services penetration in developed and developing countries. Given these differences, it is important to compare the significance of ICT services to developed and developing countries. This analysis employed a secondary data analysis method, and is reported in Chapter 4. The finding reveals that that ICT services capital significantly and positively impacts real GDP growth in developed nations but not in the developing nations studied. This result mirrors the fact that adoption of ICT services is greater in developed than developing nations, and answers Q1. Further, this analysis has confirmed that ICT services were found to complement gross capital investment in determining economic growth, both in developed and developing countries. In addition, ICT infrastructure investment complements ICT services growth in both developed and developing countries. Therefore, Q2 is answered by these results. In contrast, there is no evidence of labour contribution, neither by itself nor through collaboration with ICT services capital. Overall, these findings have provided an understanding from the global perspective, that ICT services play a significant role in the national economy, either by itself or through a collaboration with other growth factors, namely total capital and infrastructure capital. However, the way ICT services contribute to the economic growth is not the same for the developed and developing countries groups.

Fourthly, Chapter 5 presents two secondary data analyses about the Indonesia context. The first analysis moved the global perspective analysis described in Chapter 4 to focus on the Indonesian context. It examined the importance of ICT services to Indonesia's economy. The result shows similar finding to the developed country group. ICT services positively contribute to the growth of the Indonesian economy, either by itself or by working with total capital.

Next, the analysis has studied the SME role in Indonesia's economy. The findings have confirmed that SMEs contribute to Indonesia's economic growth through labour, either the labour by itself or through the collaboration between labour and the total capital. Furthermore, the lag -1 ang lag -2 SMEs total capital by itself also positively contributes to the current economic growth. Further analysis that elaborate these findings with the findings from the investigation of the ICT services role on SMEs, explained in Chapter 7, provide an answer for Q3.

A unique and comprehensive dataset about ICT services utilisation on SMEs is provided in Chapter 6. The primary data has been collected through a field survey in four cities in Indonesia, from March to November 2015. The primary data provide a panel dataset of 399 SMEs over the period 1998 to 2014. The data covers SME total capital, labour, ICT capital, and ICT services capital. The data was used to examine the influence of ICT services on SMEs. The analysis is provided in Chapter 7.

In addition, the primary data provides a set of binary data from 399 SMEs. The data covers management factors (gender, age, education), employee factors (age, education and ICT literacy), industry factors (business type, business scale, business maturity, and location), innovation factors (competitor knowledge, continuous improvement, and R&D), also the other ICT factors (computer, fix telephone, mobile telephone, Internet, and cloud computing). The data have been used to analyse the factors affecting the ICT services adoption, specifically the Cloud Computing adoption, by SMEs. The results are presented in Chapter 8.

As a sixth contribution, the empirical evidence of the role of ICT services in SMEs, that influences Indonesia's economic growth, is presented in Chapter 7. This analysis is the most critical part of this study, and answers Q3. Applying a primary data analysis and panel estimation method, this investigation has identified the following findings. ICT service capital significantly contributes to the growth in SME output. Fixed-line and mobile telephones are the main contributors. In addition, ICT services capital also works together with total capital and labour, to accelerate SME output. Taken together with the previous findings in Chapter 5, it could be argued that ICT services contribution to Indonesia's economic growth is significantly affected by SME utilisation. The contribution is mainly through the collaboration between ICT services and labour. ICT services facilitate SME labour to accelerate the SMEs output increases, that contributes to growth in the Indonesian economy. This empirical evidence from the primary data analysis is a significant contribution to knowledge and has practical implications for future policy directions.

Chapter 8 reveals the factors influencing SME adoption of ICT services, specifically Cloud Computing. This analysis utilised the primary data, presented in Chapter 6. It combined two prominent technology adoption frameworks. The first framework, TAM, represents the individual perspective, while the second framework, TOE, considers the business perspective. The application of those two frameworks is a proposed algorithm that provides a theoretical contribution to the body of knowledge. In addition, empirical findings from the primary data analysis about factors influencing the ICT services adoption provide a practical contribution. Out of the five group factors examined, the following factors have been found to impact the adoption of ICT services. Businesses with the following factors are more likely to adopt fixed-line telephones: (1) middle aged management (30-40 years old), (2) assembly base firm, (3) more mature firms, (4) larger firm size, (5) location in Denpasar, (6) higher education level, (7) lower ICT skills, (8) competitor knowledge. On the other hand, two factors were found that made the business less likely to use fixed-line telephones: (1) firms located in Jakarta, and (2) firms that use mobile telephones. For the mobile telephones, the factors that were identified to be significant were only slightly different to the other factors. However, it is interesting to note that the businesses using fixed-line telephones are also less likely to use mobile telephones. The factors that affect the adoption of the Internet are: (1) younger management age, (2) new comer firms, (3) small size firms, (4) higher employee ICT skills, (5) computer, (6) cloud computing. These findings answer Q4. Finally, Q5 was answered by the following finding. Businesses that have the following factors are more likely to implement Cloud Computing: (1) more mature firm, (2) firms that employing young age employee, with high school education and high ICT skill, (3) firms that conduct R&D, and (4) firms that has been using computer and Internet. On the other hand, firms that located in Semarang are the least likely to utilise Cloud Computing.

9.3 Findings

The study commenced with a cross-country analysis to get the global overview and then proceeded to focus on the Indonesia context. Empirical models have been constructed to address the broad research objective: to investigate the role of ICT services in improving SME output and boosting Indonesia's economic growth. The following findings lead to this research objective, through answering five research questions.

9.3.1 The influence of ICT services on economic growth

The role of ICT as a growth enhancing factor has been examined by a plethora of empirical studies. Most of these studies imply a positive and significant link between ICT and economic growth (Jorgenson and Stiroh, 1999; Thompson Jr. and Garbacz, 2007; Samoilenko and Osei-Bryson, 2008; Djiofack-Zebaze and Keck, 2009; Ketteni et al., 2011; Lee et al., 2011; Colombo et al., 2013; Forero, 2013; Dedrick et al., 2013, Turen et all., 2016). However, some of the earlier studies also found that ICT does not influence economic growth, specifically in developing nations (Djiofack-Zebaze and Keck, 2009, Matambalya and Wolf, 2001; Kupussamy et al., 2013; Ishida, 2015; Irawan, 2013; Zelenyuk, 2014). Nonetheless, only a view studies considered ICT as ICT services (Thompson Jr. and Garbacz, 2007; Turen et all., 2016). Moreover, studies on the influence of ICT services that compare developed and developing nations were limited.

The results from the cross-country analysis to examine the ICT services influence on developed and developing countries economic growth in this study have identified the following findings (see Chapter 4).

First, ICT services have been confirmed as a significant and positive growth factor for the developed countries. This finding is consistent with previous studies that consider ICT as ICT services (Thompson Jr. and Garbacz, 2007; Turen et all., 2016). This finding is also consistent with studies that consider ICT as in-house ICT (Jorgenson and Stiroh, 1999; Samoilenko and Osei-Bryson, 2008; Ketteni et al., 2011), also as all ICT (Dedrick et al., 2013; Hofman et al., 2016). However, the results of this study are at odds with some of the earlier studies (see Ishida, 2015; Irawan, 2013; Zelenyuk, 2014).

Second, in developing nations, ICT services role on the economic growth was found to be insignificant. This finding supports previous finding on the developing nation that consider ICT as in-house ICT (Matambalya and Wolf, 2001; Kupussamy et al., 2013). Nonetheless, previous studies found different results to this finding. They found that ICT (in-house ICT and ICT services) significantly influences the developing nations economic growth (Djiofack-Zebaze and Keck, 2009; Dedrick et al., 2013; Hofman et al.; 2016).

9.3.2 The relationship of ICT services to other economic growth variables

Studies found that in-house ICT complement labour and other capital to grow national economies (Jorgenson and Stiroh, 1999; Samoilenko and Osei-Bryson 2008; Ketteni, 2001). As explain in Chapter 4, the following findings reveal the relationship of ICT services to other economic growth variables, resulting from the cross-country analysis.

First, ICT services when combined with capital facilitate economic growth, either in developed or developing countries. Similar result is found by Samoilenko and Osei-Bryson (2008), who found in-house ICT complemented total capital to boost the economic growth.

Second, ICT services enhancing ICT infrastructure contribute to the economic growth in both country panels. On its own, the developing nations ICT services and ICT infrastructure impact on economic growth was found to be insignificant. However, in the developed nation group, ICT services play a significant role, while ICT infrastructure is insignificant. This finding is consistent with studies done by Kuppusamy et al. (2008), where ICT infrastructure investment itself did not contribute significantly to the economic growth in several Asian countries, such as Indonesia, Philippines and Thailand.

Third, ICT services was found to not facilitate labour to increase national economy, both in developed and developing countries. It could be argued that ICT services has a different impact on various labour skill levels (Ilmakunnas and Miyakoshi, 2013). This finding is in contrast with previous studies that found in-house ICT works together with labour (Jorgenson and Stiroh, 2003; Samoilenko and Osei-Bryson 2008; Ketteni, 2001).

9.3.3 SME ICT services adoption impact on the Indonesian economy

SMEs have become an important source of Indonesian economic growth and employment. In 2013, SMEs contributed to 59.1% of total Indonesian GDP and absorbed 97.2% of Indonesian private sector employment. This figure increased from 56.1% and 96.3% in 2003, respectively (BPS, 2003-2013). Indonesian SME adoption of ICT services remains a challenge (Kartiwi and MacGregor, 2010; Santosa and Kusumawardani, 2010; Surendro and Fardani, 2014).

Previous findings explained in Section 9.3.1 and 9.3.2 confirm that ICT services have a significant impact on the national economy, either by itself (in developed nations) or through collaboration with capital and ICT infrastructure (in developed and developing countries). Moreover, studies also found that ICT (in-house and ICT services) provides benefits for SMEs (Santosa and Kusumawardani, 2010; Dachyar and Prasetya, 2012; Colombo et al. 2013; Ross and Blumenstein, 2014).

The Indonesia context analyses in this study examined the impact of ICT services on Indonesia’s economic growth (see Chapter 5), the role of SMEs in Indonesia’s economy (see Chapter 5), and the ICT services contribution to SMEs (see Chapter 7). The analyses reveal the most important contributions of the study. The finding identify that ICT services have a significant impact on Indonesia’s economy, through the utilisation of ICT services by SMEs. ICT services facilitate SME labour capital to accelerate increases in SME output, and this contributes to economic growth. The most relevant ICT services contributors are fixed telephone, mobile telephone and landline Internet. The following results explain this finding in more detail.

First, ICT services significantly contribute to Indonesian economic growth, separately and with capital. This finding supports the previous finding on the role of ICT services on developed countries economic growth (see Section 9.3.1 and 9.3.2). However, empirical evidence from Indonesia doesn't show the collaboration between ICT services with ICT infrastructure during the current year. Nonetheless, ICT services impact from the preceding year augmenting ICT infrastructure capital is found to significantly contribute to an increase in the current economy. The findings are in contrast with the global evidence. What can be explained from this finding is that there is a delay in the utilisation of ICT infrastructure in Indonesia.

Second, SMEs have been found to be a significant contributor to Indonesia's economic growth. The contribution was seen through labour, either the labour by itself or through the collaboration between labour and the capital. By itself, the contribution of capital to the current economy is found by looking at capital from the two previous years. This finding is in line with the previous studies that show SMEs are a major economic player in term of labour sources (Yoshino and Wignaraja, 2015; BPS,2003-2014).

Third, ICT services have a significant and positive influence in growing SME output, separately or through collaboration with labour and capital. This finding confirms studies in the literature that explain the benefits of ICT services to increase SME output (Colombo et al. 2013; Roos and Blumenstein, 2015). Further, this finding is in line with the previous findings, that reveal the significant impact of ICT services on Indonesia and developed countries economic growth (see the first finding, and Section 9.3.1), except the collaboration between ICT services with labour. However, labour augmenting ICT service support the second finding, that explain the significant role of labour and capital collaboration in growing Indonesia's economy.

Additionally, SMEs benefit from ICT services over a four to five years time-frame. However, if the ICT services from the previous year are considered, then the current ICT services become an insignificant contribution to increasing SME output. The results indicate that SMEs that have been implementing ICT services for more than one year, are more likely to benefit from the previous ICT services capital than the current ICT services capital.

Fourth, fixed telephone and mobile telephone are the most significant contributors to ICT services on SMEs. Additionally, the collaboration between fixed telephone and Internet contributes significantly to increase SME output. This finding indicates that landline Internet is of greater benefit to SMEs, than mobile Internet.

9.3.4 The significant factors influencing ICT services adoption by Indonesian SMEs

The benefits of ICT services for SMEs is to increase outputs through increased collaboration, reducing costs, access to new and expanded markets, and increasing access to venture capital (Ross and Blumenstein, 2014). The primary data from this study shows that SMEs believe the top four benefits of ICT services implementation are: (1) increasing sales, (2) increasing customer service, (3) time efficiency, and (4) increasing productivity Despite the benefits of ICT services, SMEs face several challenges in the implementation of ICT. Some SMEs think that ICT services are not suited to SME needs, have no benefits for the business, are difficult to implement due to a lack of knowledge and awareness, and are not secure (Kartiwi and MacGregor ,2010; Tutunea (2014)). Meanwhile, the top four challenges that have to be overcome by SMEs, according to the primary data of this study include: (1) SMEs found difficulties implementing ICT, (2) SMEs do not know which ICT solution suits their business, (3) SMEs conclude that ICT makes their work more complicated, and (4) the do not have time to implement ICT.

Previous findings, explained in Sections 9.3.1 to 9.3.3, confirm that ICT services have a significant impact on the economic growth, through the utilization by SMEs. With the objective to understand the factors that influence ICT services adoption by SMEs, this study conducted analyses to investigate the factors.

First, management factors influencing the adoption of fixed telephone and Internet. The management age was the significant factor. Businesses with middle aged management are more likely to use fixed telephone. On the other hand, businesses with younger management age are more likely to use the Internet.

Second, employee ICT competency was found to influence the adoption of Internet and fixed telephone. Businesses with employees that have higher ICT skills are more likely to utilise the Internet. In contrast, businesses with employees that have lower ICT skills are more willing to adopt fixed telephone. Additionally, employee education is also a significant factor for fixed telephone adoption, where businesses with employees with higher education levels (high school and university degree) are more likely to adopt fixed telephone. This finding supports a previous study that indicate employee education determines the adoption of ICT by SMEs (Luchetti and Sterlacchini, 2004).

Third, industry factors were a significant influence on Internet and fixed telephone adoption. The business maturity and size are factors that influence both services. New and small businesses were more likely to utilise Internet. In contrast, the businesses that are more likely to implement fixed telephone were the more mature and larger businesses. Moreover, business type and location also significantly determined fixed telephone adoption. Assembly based businesses and businesses located in Denpasar were more willing to use fixed telephone. On the other hand, firms located in Jakarta are the less likely to adopt fixed telephone.

Fourth, innovation factors influencing the adoption of fixed telephone. Businesses that are aware of their competitors are more likely to use fixed telephone.

Fifth, utilisation of other ICT services affects the adoption of fixed telephone, mobile telephone and Internet services. Fixed telephone and mobile telephone influenced each other negatively. Businesses that used fixed telephone were less likely to adopt mobile telephone, and vice versa. Moreover, the adoption of the Internet was affected by the utilisation of computers and Cloud Computing.

9.3.5 The factors influencing Cloud Computing adoption by Indonesia's SMEs

Cloud Computing is one of the key growth engines for SMEs, allowing SMEs to use state-of-the art ICT with low capital investment and volume based cost-efficient product and service charges (Ross and Blumenstein, 2015; Assante et al., 2016). However, studies have found that adoption of Cloud Computing by SMEs remains a challenge and has not occurred at the same rate as that by large enterprises (Erisman, 2013; Mohabbattalab et al., 2014; Mohlameane and Ruxwana, 2014; Ross and Blumenstein, 2015; Khan and Al-Yasiri, 2015). The studies applied either TAM (Davies, 1989, Mohabbattalab et al., 2014) or TOE (Tornatzky and Fleischer 1990, Oliviera and Martins, 2011; Erisman, 2013; Alshamila et al., 2013; Borgan et al., 2013; Lian et al, 2014, Seethamraju, 2014).

A specific study on the factors influencing Cloud Computing adoption has been conducted during this study with a different approach and models to that used in previous studies. This study combined TAM to represent the individual perspective, and TOE to represent the business perspective. In addition, this study has applied a probit choice model. Results led to the findings explained below.

First, Cloud Computing implementation by SMEs was more affected by employee factors than management factors. This study has confirmed that businesses with young employees, high school education and high level ICT competency are more likely to adopt cloud computing.

Second, business maturity and location, as industry factors, significantly influenced Cloud Computing adoption. More mature SMEs that have been in industry for more than 5 years need Cloud Computing more than new businesses. Moreover, SMEs located in Semarang, the city with medium economic growth, were the least likely to adopt Cloud Computing. The adoption of Cloud Computing was not affected by other industry factors, such as the business type and scale. This finding contradicts the previous studies which found that Cloud Computing adoption by SMEs depends on the business size (Low at al., 2011; Alshamila et al., 2013; Olivera et al., 2014). The following studies also found that business size is insignificant for Cloud Computing adoption (Wu et al., 2013, Borgan et al., 2013, Morgan and Conboy, 2013, Hsu et al., 2014, Lian et al, 2014, Seethamraju, 2014).

Third, firms that conduct R&D, are more likely to adopt Cloud Computing. This finding indicates the significant influence of the innovation factor on the adoption of Cloud Computing. This finding supports a previous study that explained the link between product innovation and the adoption of Cloud Computing (Ross and Blumenstein, 2014).

Fourth, businesses that have been using computers and the Internet, are more likely to adopt Cloud Computing. This finding supports the fact that Cloud Computing adoption is related to Internet access. Moreover, SMEs were accessing cloud based services from business computers. It was shown that the cloud services adopted are more likely to be SaaS. The primary data showed that SaaS is the preferred Cloud Computing service implemented by SMEs (see Chapter 6). Similar studies also found that SaaS is the most used Cloud Computing service by SMEs (Erisman, 2013; Bajdor and Lis, 2014; Ross and Blumenstein, 2014; Surendro and Fardani, 2014).

These findings support previous studies which found Indonesia is ready to implement Cloud Computing (Dachyar and Prasetya, 2012; Erisman, 2013; ACCA, 2016).

9.4 Practical Implications

Having identified the findings of the study there are several practical implications that should be taken into account by government, regulatory bodies and ICT service providers. These are explained in more detail below.

First, government, regulatory bodies and ICT service providers should encourage SMEs to utilise ICT services, specifically fixed telephone, mobile telephone and fixed telephone bundled with Internet to increase output in the short term. As a long term goal, adopting Cloud Computing is recommended.

Second, there should be more effort put into increasing utilisation of ICT services infrastructure through ICT services adoption, specifically for SMEs. Encouraging SMEs with young management, employees with high ICT skills, new SMEs, micro and small SMEs can be an effective way to speed up Internet adoption. In addition, bundling services that include fixed telephone, Internet, computer and Cloud Computing will entice SMEs to adopting ICT, as well as the Internet and Cloud Computing services. Meanwhile, the increase in fixed telephone utilisation may be achieved by approaching SMEs with middle-aged and high education level management, mature firms, and medium-sized SMEs.

Third, SME management should improve employee ICT skills. However, since SME management are less concerned with Cloud Computing adoption, the government, regulatory bodies and service providers should look at ways to facilitate this training. Moreover, government, regulatory bodies and service providers need to improve management awareness of benefits of ICT services to business output.

9.5 Research Limitation

This study examines the impact of ICT services in increasing SME output as a growth factor affecting Indonesia's economy. ICT services as a new explanatory variable was introduced in this study. Further, this study provides a comparative analysis of the ICT services impact on developed and developing countries economic growth, something that is limited in the literature.

A unique and comprehensive primary dataset of ICT services utilisation by 399 Indonesian SMEs, over the period 1998 to 2014, has been constructed that contributes to the body of knowledge and provides an opportunity for future studies. This study incorporated two prominent technology adoption frameworks, that represents the individual and business context. The empirical findings from this study suggests some important practical implications. However, limitations are inevitable.

First, the countries included in the global ICT services (cross-country) analysis were selected based on data availability. Some of the countries did not have data in all categories, especially for labour data, that made it infeasible to include them in the analysis. Nonetheless, the data analysed was sufficient and the countries analysed represent most regions of the world.

Second, the survey has been carried out only in four cities due to time and cost limitations. In spite of this, the selection of the four cities was based on previous studies that found ICT services utilization is more likely to be found in cities. The four cities selected were medium to high growth cities.

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Appendix A1: Definition

1. Gross Domestic Product (GDP) is the value of all final goods and services produced by an economy by both residents and non-residents.

2. Small Medium Enterprise (SME) definition is referring to The Law of Republic Indonesia Government no. 20 year 2008 regarding Micro, Small and Medium Enterprises (Undang-Undang Republik Indonesia no. 20 tahun 2008 tentang Usaha Mikro, Sedang dan Menengah), where:

a. Micro Enterprise is a company with maximum asset IDR 50,000,000 (exclude land and building) or maximum annual revenue IDR 300,000,000;

b. Small Enterprise is a company with asset between IDR 50,000,000 to IDR 500,000,000 (exclude land and building) or annual revenue between IDR 300,000,000 to IDR 2,500,000,000;

c. Medium Enterprise is a company with asset between IDR 500,000,000 to IDR 10,000,000,000 (exclude land and building) or annual revenue between IDR 2,500,000,000 to IDR 50,000,000,000.

3. Information and Communication Technology (ICT) service is the convergence of telecommunication and computing' (Gibbs and Tanner, 1997). It does not include media such as radio, television and online media, also it does not include stand-alone hardware and software. In this research, ICT services are defined as an outsourced service model comprising fixed telephone services, mobile services, Internet services, and Cloud Computing.

4. Cloud computing is a new business model and computing paradigm, which enables on-demand provisioning of computational and storage resources (Xiao and Xiao,2013). Cloud service models are:

a. Software-as-a-Service Software-as-a-Service (SaaS) is a cloud service model in which an agency accesses software on demand from a third-party vendor. The agency does not buy the software, but is provided multiple licenses to access information.

b. Platform-as–a-Service Platform-as-a-Service (PaaS) is a cloud delivery model in which a vendor provides an online development platform for an agency. Developers leverage the vendors' computing environments and can test, create and ultimately host new applications.

c. Infrastructure-as-a-Service Infrastructure-as-a-Service (IaaS) is a cloud delivery model in which a vendor provides the hardware and software and a SME can build a customized computing environment. This delivery model can provide SME with access to advanced computing power, storage, memory, bandwidth and software applications – all on demand.

Appendix A2: Questionnaire (English)

Contents

Section A: Demographic data

A.1 About yourself

1. What is your job title?

   □ Owner

   □ CEO

   □ CFO or Head of / Manager Finance or General Support

   □ CIO or Head of / Manager IT

   □ Others: ……………………………………………………………………..

2. What are your main tasks and authorities?

   □ Managing the whole company

- ☐ Managing company's financial
- ☐ Managing company's ICT
- ☐ Others: ……………………………………………………………………..

3. What is your gender?
   - ☐ Male
   - ☐ Female
4. How old are you? (in years old)
   - ☐ 18-30
   - ☐ 31-40
   - ☐ 41-50
   - ☐ 51-60
   - ☐ >60
5. What is your highest education?
   - ☐ < high school
   - ☐ High school
   - ☐ D1
   - ☐ D2
   - ☐ D3
   - ☐ S1
   - ☐ S2
   - ☐ S3

A.2 About your company

1. What industry sector is your company in?
   - ☐ Agriculture
   - ☐ Mining
   - ☐ Manufacturing
   - ☐ Electricity and Utilities

- ☐ Construction
- ☐ Trading, Hotel and Restaurant
- ☐ Transportation and Communication
- ☐ Financial and leasing
- ☐ Other services

2. How would you best describe your business?
   - ☐ Retail
   - ☐ Wholesale
   - ☐ Reseller
   - ☐ Assembly
3. What does your company produce?
   - ☐ Product
   - ☐ services
4. How long has your company in this industry?
   - ☐ More than 10 years
   - ☐ 5-10 years
   - ☐ 1-4 years
   - ☐ Less than 1 year
5. How many branches (excluding headquarter) does your company have?
   - ☐ More than 10 branches
   - ☐ 5-10 branches
   - ☐ 1-4 branches
   - ☐ No branch
6. Are these in the same city?
   - ☐ Yes
   - ☐ No
7. If you answer No, please name the cities……………………………………

8. How many similar business in the area?

□ <10

□ 10-50

□ 51-100

□ >100

9. Does your products or services improve regularly?

□ Yes

□ No

10. How often does it in a year

□ Once

□ Twice

□ More than twice

11. Does your company engage R&D?

□ Yes

□ No

12. How much do you spend? (in percentage of revenue)

□ <1%

□ 1%

□ 2%

□ 3%

□ 4%

□ 5%

□ >5%

Section B: ICT

1. What kind of ICT does your company use? How long they have been used?

□ Computer

□ Fixed telephone, since …………………..

□ Mobile telephone, since ………………..

□ Internet,

- DSL, since …………….
- Fibre, since ………….
- Mobile, since …………
- Satellite, since ………..

- Cloud computing:
  - Software as a service,
    - Accounting, since ………………
    - Payroll, since ……..
    - Banking, since ……..
    - Transaction, since….
    - Others,…………..…. Since ………….
  - Infrastructure as a service, since ……………
  - Platform as a service, since ……………
- On site Managed IT services:
  - Managed network, since ………………..
  - Managed collaboration, since …………..
- Off site Managed IT services:
  - Managed network, since ………………..
  - Managed collaboration, since …………..
- Others: ………………………., since: …………….

2. What are they used for?

ICT	Administration	Production	Sales	Marketing
Computer				
Fixed phone				
Mobile Phone				
Internet				

Cloud Computing				
On site Managed services				
Off site Managed services				
Other				

3. Do you know what the benefits of those ICT are for your company?
   - Yes
   - No
   - Don't know
4. Can you choose and rate those benefits from scale 1 (less beneficial) to 10 (most beneficial)?

Benefit	1	2	3	4	5	6	7	8	9	10
Administration										
Production										
Sales										
Marketing										

5. What are the reasons that your company uses the ICT services? Please choose and rate from 1 (less beneficial) to 5 (most beneficial)

Benefit	1	2	3	4	5
Increase productivity					

☐ Increase sales					
☐ Increase customer service quality					
☐ Reduce operational cost					
☐ Time efficiency or speed up the work process					
☐ Other:……………………………………………………………. ….					

6. If your company intends to use or continue to use ICT services in the next five years to support your business, what will be useful? Please choose and rate from 1 (less useful) to 5 (most useful)

Benefit	**1**	**2**	**3**	**4**	**5**
☐ Fixed telephone					
☐ Mobile telephone					
☐ Internet					
☐ Cloud computing					
☐ Managed IT services					
☐ Others: …………………………					

7. What do you think the reasons that your company will continue or use the ICT services in the future? Please choose and rate from 1 (less beneficial) to 5 (most beneficial)

Benefit	**1**	**2**	**3**	**4**	**5**
☐ Increase productivity					
☐ Increase sales					
☐ Increase customer service quality					
☐ Reduce operational cost					
☐ Time efficiency or speed up the work process					

☐ Other:………………………………………………………….					

8. What are factors hindered the use of ICT services in your company? Please choose and rate from 1 (less barrier) to 5 (most barrier)

Factor Hinders	**1**	**2**	**3**	**4**	**5**
☐ Too costly					
☐ Difficult to operate ICT (doesn't have competent resource)					
☐ Too complicated to implement					
☐ Not useful for the company					
☐ Does not suit with the way the company doing the business					
☐ Does not suit to the product or services					
☐ Does not suit to the customers					
☐ Does not secure					
☐ Does not have time to implement					
☐ Difficult to choose the most appropriate ICT services needed					
☐ Other:………………………………………………………….					

9. What do you think the factors will hinder the use of ICT services in your company in the future? Please choose and rate from 1 (less barrier) to 5 (most barrier)

Factor Hinders	**1**	**2**	**3**	**4**	**5**
☐ Too costly					
☐ Difficult to operate ICT (doesn't have competent resource)					
☐ Too complicated to implement					
☐ Not useful for the company					

☐ Does not suit with the way the company doing the business					
☐ Does not suit to the product or services					
☐ Does not suit to the customers					
☐ Does not secure					
☐ Does not have time to implement					
☐ Difficult to choose the most appropriate ICT services needed					
☐ Poor ICT service quality					
☐ Other:………………………………………………………….…					

10. Do you believe that the other firms in your industry are using ICT services?

☐ Yes

☐ No

☐ Not sure

11. If yes, what do you think they are using?

☐ Computer

☐ Fixed telephone

☐ Mobile telephone

☐ Internet

☐ Cloud computing:

- ☐ Software as a service
- ☐ Infrastructure as a service
- ☐ Platform as a service

☐ Managed IT services:

- ☐ Managed network
- ☐ Managed collaboration

☐ Others

☐ Don’t know

12. Do you think that ICT services give them benefits to grow their business?

- Yes
- No
- Don't know

13. How do you feel about the ICT services quality you are using currently?

Very bad	bad	just fine	good	very good

14. What do you expect the ICT service provider to improve? Please rate from 1 (less important) to 5 (most important)

Improvement	1	2	3	4	5
Lower price					
Better service quality					
Faster response					
Faster time to repair					
Nothing (all has been good, I am satisfied with the existing services)					

Section C: Cloud computing

1. Do you know the Cloud Computing services? If not, please go to the attachment 1. (Explanation about cloud computing)
   - Yes
   - No
2. Has your company used cloud computing?
   - Yes

☐ No
If yes, go to question 3.
If no, go to question 5

3. How long does your company use cloud computing?

   ☐ Less than 1 year

   ☐ 1-2 years

   ☐ 3-5 years

   ☐ More than 5 years

4. What kind of cloud computing are you using now?

   ☐ Software as a service

   ☐ Infrastructure as a service

   ☐ Platform as a service

5. Has the cloud computing service model encourage you to implement the ICT?

   ☐ Yes

   ☐ No

6. Do you know what the benefits of cloud computing are for your company?

   ☐ Yes

   ☐ No

7. What are the reasons that your company uses the cloud computing? Please choose and rate from 1 (less beneficial) to 5 (most beneficial)

Benefit	**1**	**2**	**3**	**4**	**5**
☐ Increase productivity					
☐ Increase sales					
☐ Increase customer service quality					
☐ Reduce operational cost					
☐ Time efficiency or speed up the work process					
☐ Other:…………………………………………………………….					

8. What are factors hindered the use of cloud computing in your company? Please choose and rate from 1 (less barrier) to 5 (most barrier)

Factor Hinders	1	2	3	4	5
☐ Too costly					
☐ Difficult to operate ICT (doesn't have competent resource)					
☐ Too complicated to implement					
☐ Not useful for the company					
☐ Does not suit with the way the company doing the business					
☐ Does not suit to the product or services					
☐ Does not suit to the customers					
☐ Does not secure					
☐ Does not have time to implement					
☐ Does not support the company's privacy					
☐ Other:…………………………………………………………… ….					

9. Does your company have a plan to use or continue to use cloud computing in the next 5 years?

   ☐ Yes, in 1 to 3 years

   ☐ Yes, in the next 4-5 years

   ☐ No, but it will be considered after 5 years

   ☐ Not at all

10. If your company intends to use or continue to use cloud computing in the next five years, what will be useful?

   ☐ Software as a service, planned in ………………

   ☐ Infrastructure as a service, planned in ……………

   ☐ Platform as a service, planned in ……………

15. What do you think the reasons that your company will continue or use the cloud computing in the future? Please choose and rate from 1 (less beneficial) to 5 (most

beneficial)

Benefit	1	2	3	4	5
☐ Increase productivity					
☐ Increase sales					
☐ Increase customer service quality					
☐ Reduce operational cost					
☐ Time efficiency or speed up the work process					
☐ Other:………………………………………………………… ….					

16. What do you think the factors will hinder the use of cloud computing in your company in the future? Please choose and rate from 1 (less barrier) to 5 (most barrier)

Factor Hinders	1	2	3	4	5
☐ Too costly					
☐ Difficult to operate ICT (doesn't have competent resource)					
☐ Too complicated to implement					
☐ Not useful for the company					
☐ Does not suit with the way the company doing the business					
☐ Does not suit to the product or services					
☐ Does not suit to the customers					
☐ Does not secure					
☐ Does not have time to implement					
☐ Difficult to choose the most appropriate ICT services needed					
☐ Other:………………………………………………………… ….					

Section D: Economic outlook

1. What do you feel about our economy currently?
   - ☐ Very positive
   - ☐ Positive
   - ☐ Negative
   - ☐ Very negative
   - ☐ Don't know
2. Do you think that it is relatively to do business currently?
   - ☐ Yes
   - ☐ No
   - ☐ Not sure
3. What do you think the macroeconomic factors affecting your business? Please choose and rate from 1 (less important) to 5 (most important), use + sign to indicate positive impact and – sign to indicate negative impact:

Factors	1	2	3	4	5
☐ Inflation					
☐ Rupiah exchange rate to US dollar (currency rate)					
☐ Our economic growth (increasing customer's affordability)					
☐ Bank lending rate					
☐ Government trade policy					
☐ BUMN support					
☐ Labour minimum salary					
☐ Increasing labour education and skill					
☐ Government tax policy					
☐ Infrastructure support (transportation, ICT, etc)					

□ Other:……………………………………………………… ….					

4. What do you feel about our economy for the next 5 years?
   - □ Very positive
   - □ Positive
   - □ Negative
   - □ Very negative
   - □ Don't know
5. Do you think that Indonesia's future economy will give positive impact to your business?
   - □ Yes
   - □ No
   - □ Don't know

Section E: Financial Performance

E1: Historical Financial Performance (1998-2014)

1. How much was your asset value in 2014 (excluding land and building)?
   - □ Less than IDR 50 million
   - □ IDR 50 million – IDR 500 million
   - □ IDR 500 million – IDR 10 billion
   - □ More than IDR 10 billion

   If you don't mind, please specify the amount: IDR ……………………………………………….
2. How much was your total revenue in 2014?
   - □ Less than IDR 50 million
   - □ IDR 51 million – IDR 100 million

- IDR 101 million – IDR 300 million
- IDR 301 million – IDR 500 million
- IDR 501 million – IDR 1.00 billion
- IDR 1.01 billion – IDR 2.50 billion
- IDR 2.51 billion – IDR 5.00 billion
- IDR 5.01 billion – IDR 10.00 billion
- IDR 10.01 billion – 20.00 billion
- IDR 20.01 billion – 30.00 billion
- IDR 30.01 billion – 40.00 billion
- IDR 40.01 billion – 50.00 billion
- More than IDR 50.00 billion

If you don't mind, please specify the amount: IDR ……………………………

3. How much was your historical annual revenue (in IDR)? If you are not sure, please go to question number 4. (If you don't mind, please specify the amount)

Year	< 50 M	51M-100M	101M-500M	501M-1B	1.001B-2.5B	2.51B-5.00B	5.01B-10B	10.01B-20B	20.01B-30B	30.01B-40B	40.01B-50B	>50B
1998												
1999												
2000												
2001												
2002												
2003												
2004												
2005												

2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												

4. How much is your average annual revenue growth from 1998 to 2014? Skip this question if you have answered question number 3.

    ☐ Less than (-10%)

    ☐ (-10%) – (-5%)

    ☐ (-5.01%) – (0%)

    ☐ 0.01% -5%

    ☐ 5.01% - 10%

    ☐ 10.01% - 15%

    ☐ 15.01% - 20%

    ☐ More than 20%

5. How much was your total expense in 2014?

    ☐ Less than IDR 5 million

    ☐ IDR 5.01 million – IDR 10 million

    ☐ IDR 10.1 million – IDR 30 million

    ☐ IDR 30.1 million – IDR 50 million

- IDR 50.1 million – IDR 100 million
- IDR 101 million – IDR 250 million
- IDR 251 million – IDR 500 million
- IDR 501 million – IDR 1billion
- IDR 1.01 billion – 2.00 billion
- IDR 2.01 billion – 3.00 billion
- IDR 3.01 billion – 4.00 billion
- IDR 4.01 billion – 5.00 billion
- More than IDR 5.00 billion

If you don't mind, please specify the amount: IDR ……………………………………………….

6. How much was your historical annual expense (1998-2013)? If you are not sure, please go to question number 7. (If you don't mind, please specify the amount)

Year	< 5 M	5.1M -10M	10.1M -50M	50.1M - 100M	101M-250M	251M-500M	501M -1B	1.01B-2B	2.01B-3B	3.01B-4B	4.01B-5B	>5B
1998												
1999												
2000												
2001												
2002												
2003												
2004												
2005												
2006												

2007												
2008												
2009												
2010												
2011												
2012												
2013												

7. How much is your average annual expense growth from 1998 to 2014? Skip this question if you have answered question number 5.

    - ☐ Less than (-10%)
    - ☐ (-10%) – (-5%)
    - ☐ (-5.01%) – (0%)
    - ☐ 0.01% -5%
    - ☐ 5.01% - 10%
    - ☐ 10.01% - 15%
    - ☐ 15.01% - 20%
    - ☐ More than 20%

8. How much was your investment in 2014?

    - ☐ Less than IDR 5 million
    - ☐ IDR 5.01 million – IDR 10 million
    - ☐ IDR 10.1 million – IDR 30 million

- IDR 30.1 million – IDR 50 million
- IDR 50.1 million – IDR 100 million
- IDR 101 million – IDR 250 million
- IDR 251 million – IDR 500 million
- IDR 501 million – IDR 1billion
- IDR 1.01 billion – 2.00 billion
- IDR 2.01 billion – 3.00 billion
- IDR 3.01 billion – 4.00 billion
- IDR 4.01 billion – 5.00 billion
- More than IDR 5.00 billion

If you don't mind, please specify the amount: IDR ……………………………………………….

9. How much was your historical annual investment (1998-2013)? If you are not sure, please go to question number 10. (If you don't mind, please specify the amount)

Year	< 5 M	5.1M -10M	10.1M -50M	50.1M - 100M	101M-250M	251M-500M	501M -1B	1.01B-2B	2.01B-3B	3.01B-4B	4.01B-5B	>5B
1998												
1999												
2000												
2001												
2002												
2003												
2004												
2005												

2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												

10. How much is your average annual investment growth from 1998 to 2013? Skip this question if you have answered question number 9.

    ☐ Less than (-10%)

    ☐ (-10%) – (-5%)

    ☐ (-5.01%) – (0%)

    ☐ 0.01% -5%

    ☐ 5.01% - 10%

    ☐ 10.01% - 15%

    ☐ 15.01% - 20%

    ☐ More than 20%

11. How much did you spend on total ICT in 2014 (including hardware and software)? See the total ICT definition

    ☐ Less than IDR 500 thousand

    ☐ IDR 501 thousand – IDR 1 million

    ☐ IDR 1.1 million – IDR 3 million

- IDR 3.1 million – IDR 5 million
- IDR 5.1 million – IDR 10 million
- IDR 10.1 million – IDR 25.0 million
- IDR 25.1 million – IDR 50.0 million
- IDR 50.1 million – IDR 100 million
- IDR 101 million – 200 million
- IDR 201 million – 300 million
- IDR 301 million – 400 million
- IDR 401 million – 500 million
- IDR 501 million – 1 billion
- More than IDR 1 billion

If you don't mind, please specify the amount: IDR ………………………………

12. How much did you spend on total ICT from 1998 to 2013(in IDR)? If you are not sure, please go to question number 13. (If you don't mind, please specify the amount). If you already answered this question, go to question number 14.

Year	< 500T	501T -1M	1.1M- 5M	5.1M- 10M	10.1M- 25M	25.1M -50M	50.1 M- 100M	101M- 200M	201M- 300M	301M- 400M	401M- 500M	>500M
1998												
1999												
2000												
2001												
2002												
2003												
2004												

2005												
2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												

13. How much did you increase or decrease your annual ICT services spending from 1998 to 2013?

    - ☐ Less than (-10%)
    - ☐ (-10%) – (-5%)
    - ☐ (-5.01%) – (0%)
    - ☐ 0.01% -5%
    - ☐ 5.01% - 10%
    - ☐ 10.01% - 15%
    - ☐ 15.01% - 20%
    - ☐ More than 20%

14. How did you spend on ICT services (ICT outsource) in 2014? See the ICT services definition.

- Less than IDR 500 thousand
- IDR 501 thousand – IDR 1 million
- IDR 1.1 million – IDR 3 million
- IDR 3.1 million – IDR 5 million
- IDR 5.1 million – IDR 10 million
- IDR 10.1 million – IDR 25.0 million
- IDR 25.1 million – IDR 50.0 million
- IDR 50.1 million – IDR 100 million
- IDR 101 million – 200 million
- IDR 201 million – 300 million
- IDR 301 million – 400 million
- IDR 401 million – 500 million
- IDR 501 million – 1 billion
- More than IDR 1 billion

If you don't mind, please specify the amount: IDR ……………………………….

15. How much did you spend on ICT services last year (2014, in IDR)? If you are not sure, please go to question number 16. (If you don't mind, please specify the amount). If you already answered this question, please go to question number 17.

Year	< 500 T	501T -1M	1.1M-5M	5.1M-10M	10.1M-25M	25.1M -50M	50.1 M-100M	101M-200M	201M-300M	301M-400M	401M-500M	>500M
1998												
1999												
2000												
2001												
2002												

2003												
2004												
2005												
2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												

16. How much did you increase or decrease your annual ICT services spending from 1998 to 2013?

- ☐ Less than (-10%)
- ☐ (-10%) – (-5%)
- ☐ (-5.01%) – (0%)
- ☐ 0.01% -5%
- ☐ 5.01% - 10%
- ☐ 10.01% - 15%
- ☐ 15.01% - 20%

- More than 20%

17. How much was your labour cost in 2014?

- Less than IDR 10M
- IDR 10.1 million – IDR 30 million
- IDR 30.1 million – IDR 50 million
- IDR 50.1 million – IDR 100 million
- IDR 100.1 million – IDR 250.0 million
- IDR 250.1 million – IDR 500.0 million
- IDR 500.1 million – IDR 1 billion
- IDR 1.01 billion – 2.00 billion
- IDR 2.01 billion – 3.00 billion
- IDR 3.01 billion – 4.00 billion
- IDR 4.01 billion – 5.00 billion
- IDR 5.01 billion – 10 billion
- More than IDR 10.00 billion

If you don't mind, please specify the amount: IDR ……………………………….

18. How much was your historical labour cost from 1998 to 2013? (If you don't mind, please specify the amount).

If you are not sure, please go to question number 19.

If you already answered this question, please go to section 3

Year	< 10M	10.1 M-30M	30.1M -50M	50.1M - 100M	100.1 M-250M	250.1 M-500M	500.1 M-1B	1.01B-2B	2.01B-3B	3.01B-4B	4.01B-5B	>5B
1998												
1999												
2000												
2001												
2002												
2003												

2004												
2005												
2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												
2014												

19. How much is your average annual labour cost growth from 1998 to 2014? Skip this question if you have answered question number 18.

    ☐ Less than (-10%)

    ☐ (-10%) – (-5%)

    ☐ (-5.01%) – (0%)

    ☐ 0.01% -5%

    ☐ 5.01% - 10%

    ☐ 10.01% - 15%

    ☐ 15.01% - 20%

    ☐ More than 20%

E.2 : Future Financial Projection (2015-2020)

1. Does your company expect to increase the revenue in the next five years?

    ☐ Yes, please fill in the following table (thick or write the number)

Year	< 1%	1-5%	5-10%	10-15%	15-20%	20-25%	25-30%	>30%
2015								
2016								
2017								
2018								
2019								
2020								

    ☐ No

2. Does your company expect to increase or decrease the expense in the next 5 years?

    ☐ Yes, please fill in the following table (thick or write the number)

Year	< 5M	5.1M -10M	10.1M -50M	50.1M - 100M	101M-250M	251M-500M	501M -1B	1.01B-2B	2.01B-3B	3.01B-4B	4.01B-5B	>5B
2015												
2016												
2017												
2018												

2019												
2020												

☐ No

3. Does your company expect to increase or decrease the investment in the next 5 years

   ☐ Yes, please fill in the following table (thick or write the number, use (-) to indicate the reduction, and (+) to indicate the increase).

Year	0%	0-2.5%	2.51%-5%	5.01%-7.5%	7.51%-10%	10.01%-12.5%	12.51%-15%	15.01%-17.5%	17.51%-20%	>20%
2015										
2016										
2017										
2018										
2019										
2020										

☐ No

4. Does your company expect to increase or decrease the total ICT expense in the next 5 years

   ☐ Yes, please fill in the following table (thick or write the number, use (-) to indicate the reduction, and (+) to indicate the increase).

Year	0%	0-2.5%	2.51%-5%	5.01%-7.5%	7.51%-10%	10.01%-12.5%	12.51%-15%	15.01%-17.5%	17.51%-20%	>20%

2015									
2016									
2017									
2018									
2019									
2020									

 No

5. Does your company expect to increase or decrease the ICT services expense in the next 5 years

     Yes, please fill in the following table (thick or write the number, use (-) to indicate the reduction, and (+) to indicate the increase).

Year	0%	0-2.5%	2.51%-5%	5.01%-7.5%	7.51%-10%	10.01%-12.5%	12.51%-15%	15.01%-17.5%	17.51%-20%	>20%
2015										
2016										
2017										
2018										
2019										
2020										

 No

6. Does your company expect to increase or decrease the total labour expense in the next 5 years

    - ☐ Yes, please fill in the following table (thick or write the number, use (-) to indicate the reduction, and (+) to indicate the increase).

Year	0%	0-2.5%	2.51%-5%	5.01%-7.5%	7.51%-10%	10.01%-12.5%	12.51%-15%	15.01%-17.5%	17.51%-20%	>20%
2015										
2016										
2017										
2018										
2019										
2020										

    - ☐ No

Section F: Labour

F.1 Historical Labour Data (1998-2014)

1. How many employees does your company have currently (2014)?

    - ☐ Less than 2
    - ☐ 2 - 5
    - ☐ 6 - 10
    - ☐ 11 -50
    - ☐ 51 - 100
    - ☐ 101 - 200
    - ☐ 201 - 300

☐ 301 - 400

☐ 401 - 500

☐ 501 - 600

☐ 601 - 700

☐ 701 - 800

☐ 801 – 900

☐ 900 - 1000

☐ More than 1000

If you don’t mind, please specify the number: ……………………………………………….

2. How many employees worked in your company since 1998? If you are not sure, please go to question number 3. (If you don’t mind, please specify the number).

Year	< 2	2-5	6-10	11-50	51-100	101-200	201-300	301-400	401-500	501-600	601-700	701-800	801-900	901-1000	>1000
1998															
1999															
2000															
2001															
2002															
2003															
2004															
2005															
2006															
2007															

2008															
2009															
2010															
2011															
2012															
2013															
2014															

3. How much is your average annual employee number growth from 1998 to 2014? Skip this question if you have answered question number 2.

   ☐ Less than (-10%)

   ☐ (-10%) – (-5%)

   ☐ (-5.01%) – (0%)

   ☐ 0.01% -5%

   ☐ 5.01% - 10%

   ☐ 10.01% - 15%

   ☐ 15.01% - 20%

   ☐ More than 20%

4. Do your employees work 8 hours a day?

   ☐ Yes

   ☐ No, how many hours? ……… hours

5. Do your employees work 5 days a week?

   ☐ Yes

   ☐ No, how many days? …….. days

6. Do the employees engage an overtime?

    ☐ Yes, how many hours per week? ……….. hours

    ☐ No

7. Did the employees work with the same working hours and overtime as in 2014, since 1998?

    ☐ Yes

    ☐ No, please specify their working hours and overtime in the following table

Year	**Daily working hours**			**Weekly working days**			**Weekly overtime**		
	<8hrs	**8hrs**	**>8hrs**	**<5days**	**5 days**	**>5days**	**<20 hrs**	**20 hrs**	**>20hrs**
1998									
1999									
2000									
2001									
2002									
2003									
2004									
2005									
2006									
2007									
2008									
2009									

2010									
2011									
2012									
2013									

8. What were the age compositions of your employee in 2014?

 - □ < 30 years: …….. %
 - □ 31-40 years: ……..%
 - □ 41-50 years: ………%
 - □ > 50 years: ………. %

9. Did these compositions change since 1998?

 - □ Yes, please fill in the following table

Year	Age composition (in percent) or number			
	<30 years	31-40 years	41-50 years	50 years
1998				
1999				
2000				
2001				
2002				
2003				
2004				

2005				
2006				
2007				
2008				
2009				
2010				
2011				
2012				
2013				

- □ No

10. What are the highest education level of your employees currently?

- □ Less than high school: specify number or percentage ………………
- □ High school: please specify number or percentage ………………
- □ D1: please specify number or percentage ………………
- □ D2: please specify number or percentage ………………
- □ D3: please specify number or percentage ………………
- □ S1: please specify number or percentage ………………
- □ S2: please specify number or percentage ………………
- □ S3: please specify number or percentage ………………

11. What were the education level of your employees since 1998 (in number or percentage of total employees or yearly growth)?

Year	<HS	HS	D1	D2	D3	S1	S2	S3
1998								
1999								
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007								
2008								
2009								
2010								
2011								
2012								
2013								
2014								

12. How many employees do you have in this position in 2014?

- ☐ Staffs: please specify number or percentage ………………
- ☐ Supervisors or managers: please specify number or percentage ………………

□ Senior managers: please specify number or percentage ………………

□ Directors: please specify number or percentage ………………

13. How many of them are ICT literates?

□ Low: please specify number or percentage ………………

□ Medium: please specify number or percentage ………………

□ High: please specify number or percentage ………………

F.2 Future Labour Data (2015-2020)

1. Does your company plan to change these compositions in the next 5 years?

□ Yes, please fill in the following table

Year	Age composition (in percent) or number			
	<30 years	31-40 years	41-50 years	50 years
2015				
2016				
2017				
2018				
2019				
2020				

□ No

2. Does your company plan to hire or reduce employee in the next 5 years (2015-2020)?

□ Yes, please fill in the table below (If you don't mind, please specify the number).

Please use (-) to indicate the reduction, and (+) to indicate the increase.

Year	0	0-1	2-5	6-10	11-25	26-50	51-100	101-200	201-500	>500
2015										
2016										
2017										
2018										
2019										
2020										

- ☐ No

3. Will there be any changes in the average weekly working hours for the next 5 years (2015-2020)?
   - ☐ Yes, go to the next question.
   - ☐ No (end of question)
   - ☐ Don't know (end of question)

4. Are you looking at extending the new working hours in the next 5 years?
   - ☐ Yes, please fill in the table below

Year	< 100	101-120	121-130	131-140	141-150	151-160	161-170	171-180	181-190	191-200	>200
2015											
2016											
2017											
2018											
2019											
2020											

- [ ] No
- [ ] Don't know

---end of questionnaire----------------------------------

Appendix A3: Questionnaire (Indonesia)

Daftar Isi

Bagian A: Data Demografi

A.1 Mengenai diri Anda

1. Apakah jabatan Anda?
    a. Pemilik perusahaan
    b. Direktur Utama / CEO
    c. Direktur Keuangan atau Kepala Bagian / Manager Keuangan
    d. Direktur IT atau Kepala Bagian / Manager IT
    e. Lain2: ……………………………………………………………………..
2. Apakah tugas dan tanggung jawab utaman Anda?
    a. Mengatur seluruh perusahaan

b. Mengatur Keuangan perusahaan

c. Mengoperasikan dan mengatur kebijakan ICT

d. Lain2: …………………………………………………………………..

3. Apakah jenis kelamin anda?

   a. Laki-laki

   b. Perempuan

4. Berapakah umur Anda? (dalam tahun)

   a. 18-30

   b. 31-40

   c. 41-50

   d. 51-60

   e. >60

5. Apakah pendidikan tertinggi Anda?

   a. < SMA

   b. SMA

   c. D1

   d. D2

   e. D3

   f. S1

   g. S2

   h. S3

A.2 Mengenai Perusahaan Anda

13. Bergerak di sektor industri apakah perusahaan Anda?

   ☐ Pertanian

   ☐ Pertambangan

   ☐ Manufacturing

   ☐ Electricity and Utilities

- Konstruksi
- Perdagangan, Hotel and Restoran
- Transportasi and Komunikasi
- Keuangan
- Lain2: …………………………………………………………………

14. Di bidang apakah bisnis perusahaan Anda?
    - Retail
    - Wholesale
    - Reseller
    - Assembly / perakitan
15. Apakah layanan perusahaan Anda?
    - Produk
    - Jasa
16. Berapa lama perusahaan Anda sudah ada pada industri ini?
    - Lebih dari 10 tahun
    - 5-10 tahun
    - 1-4 tahun
    - Kurang dari 1 tahun
17. Berapa kantor cabang (termasuk kantor pusat) yang dimiliki perusahaan Anda?
    - Lebih dari 10 kantor
    - 5-10 kantor
    - 1-4 branches
    - No branch
18. Apakah semua kantor berlokasi di kota yang sama?
    - Ya
    - Tidak
19. Jika tidak, mohon disebutkan di kota mana saja: …………………………………

20. Apakah Anda mengetahui berapa banyak perusahaan dengan bisnis yang serupa dengan bisnis perusahaan Anda?

□ Ya,

Berapakah jumlahnya?

□ <10

□ 10-50

□ 51-100

>100

□ Tidak

21. Apakah produk atau jasa perusahaan Anda diperbaiki secara rutin?

□ Ya

□ Tidak

22. Seperapa sering perbaikan dilakukan dalam satu tahun?

□ Satu kali

□ Dua kali

□ Lebih dari dua kali

23. Apakah perusahaan Anda melakukan penelitian dan pengembangan?

□ Ya

□ Tidak

24. Berapa % dari pendapatan alokasi biaya penelitian dan pengembangan?

□ <1%

□ 1%

□ 2%

□ 3%

□ 4%

□ 5%

□ >5%

Bagian B: Information and Communication Technology (ICT)

17. Jenis ICT apa saja yang digunakan perusahaan Anda? Sejak kapan telah digunakan?

- Komputer, sejak tahun ………………………..
- Telepon tetao, sejak tahun …………………..
- Telepon seluler, sejak tahun ………………..
- Internet,
    - DSL (menggunakan akses kabel tembaga), sejak tahun …………….
    - Fibre Optic (menggunakan akses fibre optic), sejak tahun ………….
    - Selular, sejak tahun …………
    - Satellite, sejak tahun ………..
    - Tidak tahu teknologi akses yang digunakan, sejak tahun ………………
- Cloud computing:
    - Software as a service,
        - Accounting, sejak tahun …………
        - Payroll, sejak tahun …………
        - Banking, sejak tahun …………
        - Transaction, sejak tahun …………
        - Lain-lain,…………..………………………. sejak tahun …………
    - Infrastructure as a service, sejak tahun …………
    - Platform as a service, sejak tahun …………
- On site Managed IT services:
    - Managed network, sejak tahun …………
    - Managed collaboration, sejak tahun …………
- Off site Managed IT services:
    - Managed network, sejak tahun …………
    - Managed collaboration, sejak tahun …………
    - Lain-lain: ………………………., sejak tahun …………

18. Untuk apa sajakah ICT tersebut digunakan?

ICT	Administrasi	Produksi	Sales	Marketing	Lain2
Komputer					
Telepon tetap					
Telepon seluler					
Internet					
Cloud Computing					
On site Managed services					
Off site Managed services					
Lain-lain					

19. Apakah Anda tahu manfaat ITC tersebut bagi perushaan Anda?
    - ☐ Ya
    - ☐ Tidak

20. Mohon berikan penilaian terhadap manfaat ICT bagi perusahaan Anda, dari nila 1 (paling rendah) sampai nila 10 (paling tinggi) manfaatnya.

Manfaat	1	2	3	4	5	6	7	8	9	10

Administrasi										
Produksi										
Penjualan/sales										
Marketing										
Lain-lain										

21. Apakah alasan perusahaan Anda menggunakan ICT? Mohon memberikan penilaian dari nilai 1 (paling rendah) sampai 10 (paling tinggi)

Manfaat	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
☐ Meningkatkan produktivitas										
☐ Meningkatkan penjualan / sales										
☐ Meningkatkan customer service quality										
☐ Menguangi biaya operasional										
☐ Efisiensi waktu atau mempercepat proses kerja										
☐ Lain-lain : …………………………………………										

22. Apabila perusahaan Anda bermaksud mulai atau melanjutkan penggunaan ICT services dalam kurun 5 tahun mendatang dengan tujuan untuk mendukung bisnis, apakah yang akan bermanfaat? Mohon memberikan penilaian dari nilai 1 (paling rendah) sampai 10 (paling tinggi)

Manfaat	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
☐ Komputer										
☐ Telepon tetap										
☐ Telepon seluler										
☐ Internet										
☐ Cloud Computing										

□ On site Managed services										

23. Apakah alasan perusahaan Anda menggunakan ICT tersebut dalam waktu 5 tahun mendatang? Mohon memberikan penilaian dari nilai 1 (paling rendah) sampai 10 (paling tinggi)

Manfaat	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
□ Meningkatkan produktivitas										
□ Meningkatkan penjualan / sales										
□ Meningkatkan customer service quality										
□ Menguangi biaya operasional										
□ Efisiensi waktu atau mempercepat proses kerja										
□ Lain-lain : …………………………………………… …………….										

24. Faktor-faktor apa sajakah yang menghambat pemggunaan ICT di perusahaan Anda? Mohon memberikan penilaian dari nilai 1 (paling rendah) sampai 10 (paling tinggi)

Faktor-faktor yang menghalangi	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
□ Terlalu mahal										
□ Terlalu sulit untuk digunakan (tidak ada karyawan yang ahli IT)										
□ Terlalu rumit untuk diimpelentasikan										
□ Tidak bermanfaat bagi perusahaan										
□ Tidak sesuai dengan cara perusahaan menjalankan bisnis										
□ Tidak sesuai dengan produk atau jasa										

□ Tidak sesuai dengan pelanggan										
□ Tidak aman										
□ Tidak ada waktu untuk mengimplementasikan										
□ Kesulitan menentukan ICT yang diperlukan perusahaan										
□ Lain-lain:………………………………………										

25. Faktor-faktor apa sajakah yang menghambat pemggunaan ICT di perusahaan Anda? Mohon memberikan penilaian dari nilai 1 (paling rendah) sampai 10 (paling tinggi)

Faktor-faktor yang menghalangi	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
□ Terlalu mahal										
□ Terlalu sulit untuk digunakan (tidak ada karyawan yang ahli IT)										
□ Terlalu rumit untuk diimpelentasikan										
□ Tidak bermanfaat bagi perusahaan										
□ Tidak sesuai dengan cara perusahaan menjalankan bisnis										
□ Tidak sesuai dengan produk atau jasa										
□ Tidak sesuai dengan pelanggan										
□ Tidak aman										
□ Tidak ada waktu untuk mengimplementasikan										
□ Kesulitan menentukan ICT yang diperlukan perusahaan										
□ Lain-lain:……………………………………										

26. Apakah Anda mengetahui bahwa perusahaan lain di industri yang sama dengen perusahaan Saudara juga menggunkan ICT?

- Ya
- Tidak
- Tidak yakin

27. Jika ya, apa yang mereka gunakan?
    - Komputer
    - Telepon tetap
    - Telepon selular
    - Internet
    - Cloud computing:
        - Software as a service
            - Accounting, sejak tahun …………
            - Payroll, sejak tahun …………
            - Banking, sejak tahun …………
            - Transaction, sejak tahun …………
            - Lain-lain
        - Infrastructure as a service
        - Platform as a service
    - On site Managed IT services:
        - Managed network
        - Managed collaboration
    - Off site Managed IT services:
        - Managed network
        - Managed collaboration
    - Tidak tahu layanan yg mereka gunkan
28. Apakah menurut Anda ICT yang merke gunakan membantu pertumbuhn bisnis mereka?
    - Ya
    - Tidak
    - Tidak tahu

29. Menurut Anda, bagaiaan kualitas layanan ICT yang saat ini anda gunakanHowkan? Mohon memberikan penilaian dari nilai 1 (paling rendah) sampai 10 (paling tinggi)

Manfaat	1	2	3	4	5	6	7	8	9	10
☐ Telepon tetap										
☐ Telepon seluler										
☐ Internet										
☐ Cloud Computing										
☐ On site Managed services										
☐ On site Managed services										

30. Perbaikan spakah yang Anda harapkan dari ICT service provider? Mohon memberikan penilaian dari nilai 1 (paling tidak penting) sampai 10 (paling penting)

Improvement	1	2	3	4	5	6	7	8	9	10
☐ Harga lebih murah										
☐ Kualitas layanan lebih baik										
☐ Layanan lebih cepat dan reponsif										
☐ Waktu perbaikan lebih cepat										
☐ Tidak ada (layanan saat										

ini sudah sangat bagus)										

Bagian C: Cloud computing

11. Apakah Anda mengetahui layanan Cloud Computing? Jika tidak, mohon untuk mmbaca definisi di lampiran 1. (Pejelasan mengenai cloud computing)

    - ☐ Ya
    - ☐ Tidak

12. APakah perusahaan Anda sudah menggunakan layanan cloud computing?

    - ☐ Ya
    - ☐ Tidak. Silakan lanjut ke pertanyaan no 5

13. Berapa lama perusahaan Anda telah menggunakan cloud computing?

    - ☐ Kurang dari 1 tahun
    - ☐ 1-2 tahun
    - ☐ 3-5 tahun
    - ☐ Lebih dari 5 tahun

14. Cloud computing apakah yg Anda gunakan sekarang?

    - ☐ Software as a service
    - ☐ Infrastructure as a service
    - ☐ Platform as a service

15. Apakah cloud computing mempermudah Anda dalam menggunakan ICT?

    - ☐ Ya
    - ☐ Tidak

16. Apakah anda mengetahui manfaat cloud computing bagi perusahaan Anda?

    - ☐ Ya
    - ☐ Tidak

31. Apakah alasan Perusahaan Anda menggunakan cloud computing? Mohon memberikan penilaian dari nilai 1 (paling rendah) sampai 10 (paling tinggi)

Manfaat	1	2	3	4	5	6	7	8	9	10
Meningkatkan produktivitas										
Meningkatkan penjualan / sales										
Meningkatkan customer service quality										
Menguangi biaya operasional										
Efisiensi waktu atau mempercepat proses kerja										
Lain-lain : …………………………………………										

32. Faktor-faktor apa sajakah yang menghambat pemggunaan cloud computing di perusahaan Anda? Mohon memberikan penilaian dari nilai 1 (paling rendah) sampai 10 (paling tinggi)

Faktor-faktor yang menghalangi	1	2	3	4	5	6	7	8	9	10
Terlalu mahal										
Terlalu sulit untuk digunakan (tidak ada karyawan yang ahli IT)										
Terlalu rumit untuk diimpelentasikan										
Tidak bermanfaat bagi perusahaan										
Tidak sesuai dengan cara perusahaan menjalankan bisnis										
Tidak sesuai dengan produk atau jasa										
Tidak sesuai dengan pelanggan										
Tidak aman										
Tidak ada waktu untuk mengimplementasikan										
Kesulitan menentukan ICT yang diperlukan perusahaan										
Lain-lain:…………………………………										

17. Apakah perusahaan Anda akan menggnakan atau melanjutkan penggunaan cloud computing dalam 5 tahun mendatang?

 Ya, dalam 1-3 tahun

 Ya, dalam waktu 4-5 tahun

 Tidak, tetapi ada kemungkinan setelah 5 tahun

 Tidak sama sekali

 Tidak tahu

18. Jika perusahaan Anda akan menggunkan atau melanjutkan peggunaan cloud computing, apakh yang akan bermanfaat?

 Software as a service, recana tahun ………………

 Infrastructure as a service, rencana tahun ……………

 Platform as a service, rencana tahun ……………

19. Menurut Anda, Apakah alasan Perusahaan Anda menggunakan cloud computing di masa mendatang? Mohon memberikan penilaian dari nilai 1 (paling rendah) sampai 10 (paling tinggi)

Manfaat	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Meningkatkan produktivitas										
Meningkatkan penjualan / sales										
Meningkatkan customer service quality										
Menguangi biaya operasional										
Efisiensi waktu atau mempercepat proses kerja										
Lain-lain : …………………………………………										

33. Menurut Anda, Faktor-faktor apa sajakah yang menghambat pemggunaan cloud computing di perusahaan Anda di masa mendatang? Mohon memberikan penilaian dari nilai 1 (paling rendah) sampai 10 (paling tinggi)

Faktor-faktor yang menghalangi	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

□ Terlalu mahal										
□ Terlalu sulit untuk digunakan (tidak ada karyawan yang ahli IT)										
□ Terlalu rumit untuk diimpelentasikan										
□ Tidak bermanfaat bagi perusahaan										
□ Tidak sesuai dengan cara perusahaan menjalankan bisnis										
□ Tidak sesuai dengan produk atau jasa										
□ Tidak sesuai dengan pelanggan										
□ Tidak aman										
□ Tidak ada waktu untuk mengimplementasikan										
□ Kesulitan menentukan ICT yang diperlukan perusahaan										
□ Lain-lain:……………………………………										

Bagian D: Outlook Perekonomian

1. Menurut Anda, bagaimanakh kondidi perekonomian Indonesia saat ini?
    a. Sangat positif
    b. Positif
    c. Negatif
    d. Sangat negatif
    e. Tidak tahu
2. Menurut Anda, apakah saat ini sangat mngtungkan untuk menjalankan bisnis?
    a. Ya
    b. Tidak

c. Tidak yakin

3. Menurut Anda, factor-fktor makro ekonomi apa saja yang mempengaruhi bisnis perusahaan Ada? Silakan memilih dan memberikan penilaian di bawah ini, dengan nilai 1 (paling tidak berpengaruh) sampai 10 (paling berpengaruh), dan gunakn tanda + untuk pengaruh positif dan tanda (–)untuk pengaruh negatif.

Faktor	**1**	**2**	**3**	**4**	**5**	**5**	**7**	**8**	**9**	**10**
☐ Inflasi										
☐ Nilai tukar rupiah terhadap valas (terutama US$)										
☐ Pertumbuhan ekonomi Indonesia (peningkatan daya beli masyarakat)										
☐ Tingkat suku bunga bank										
☐ Kebijakan perdagangan pemerintah Indonesia										
☐ Dukungan BUMN										
☐ Upah minimum regional										
☐ Peningkatan pendidikan dan ketrampilan karyawan										
☐ Kebijakn perpajakan pmerintah Indonesia										
☐ Dukungan infrastruktur (transportasi, ICT, dll)										
☐ Lain-lain : ………………………………………										

4. Menurut Anda, bagaimana perekonomian Indonesia 5 tahun mendatang?
   a. Sangat positif
   b. Positif
   c. Negatif
   d. Sangat negative
   e. Tidak tahu

5. Menurut Anda, apakah pereekonomian Indonesia dimasa mendatang akan memberikan dampak positif bagi bisnis perusahaan Anda?
   a. Ya
   b. Tidak
   c. Tidak tahu

Bagian E: Performansi Keuangan

E1: Performasi Keuangan Historis (1998-2014)

20. Berapakah nilai aset Perusahaan Anda pada akhir tahun 2014? (tidak termasuk tanah dan bangunan)?
    - Kurang dari Rp 50 juta
    - Rp 50 juta – Rp 500 juta
    - Rp 501 juta – Rp 10 miliar
    - Lebih dari Rp 10 miliar

    Jika tidak keberatan, mohon disebutkan jumlah nya: Rp …………………………
21. Berapakah total pendapatan (revenue) perusahaan Anda pada tahun 2014?
    - Kurang dari Rp 50 juta
    - Rp 50 juta – Rp 100 juta
    - Rp 101 juta – Rp 250 juta
    - Rp 251 juta – Rp 500 juta
    - Rp 501 juta – Rp 1 miliar
    - Rp 1 miliar – Rp 2,5 miliar
    - Rp 2,51 miliar – Rp 5 miliar
    - Rp 5,01 miliar – Rp 10 miliar
    - Rp 10,01 miliar – Rp 20 miliar
    - Rp 20,01 miliar – Rp 30 miliar
    - Rp 30,01 miliar – Rp 40 miliar
    - Rp 40,01 miliar – Rp 50 miliar

□ Lebih dari Ro 50 miliar

Jika tidak keberatan, mohon disebutkan jumlah nya: Rp …………………………

22. Berapakah pendapatan (revenue) tahunan perusahaan Anda, sejak tahun 1998-2013 (dalam rupiah), bias dengan memberikan tanga (✔) atau menuliskan jumlahnya pada table berikut? Apabila Anda tidak yakin, mohon ke pertanyaan no.4.

Tahun	< 50 jt	51jt - 100 jt	101jt-250jt	251jt-500jt	501jt-1M	1.01M -2.5M	2.51M - 5.00M	5.01M -10M	10.01M -20M	20.01M -30M0	30.01M -40M	40.01M -50M	>50 M
1998													
1999													
2000													
2001													
2002													
2003													
2004													
2005													
2006													
2007													
2008													
2009													
2010													

2011													
2012													
2013													

23. Berapakah rata-rata pertumbuhan pendatan (revenue) perusahaan Anda dari tahun 1998-2014? Lewati pertanyaan ini jika Anda sudah menjawab pertanyaan no. 3.

 □ Kurang dari (-10%)

 □ (-10%) – (-5%)

 □ (-5.01%) – (0%)

 □ 0.01% -5%

 □ 5.01% - 10%

 □ 10.01% - 15%

 □ 15.01% - 20%

 □ Lebih dari 20%

24. Berapakah total pengeluaran perusahaan Anda selama tahun 2014 (dalam rupiah)?

 □ Kurang dari Rp 5 jt

 □ Rp 5,1 jt – Rp 10 jt

 □ Rp 10,1 jt – Rp 25 jt

 □ Rp 25,1 jt – Rp 50 jt

 □ Rp 50,1 jt – Rp 100 jt

 □ Rp 100,1 jt – Rp 250 jt

 □ Rp 250,1 jt – Rp 500 jt

 □ Rp 500,1 jt – Rp 1 miliar

 □ Rp 1,1 miliar – Rp 2,5 miliar

 □ Rp 2,51 miliar – Rp 5 miliar

 □ Lebih dari Rp 5 miliar

Jika tidak keberatan, mohon disebutkan jumlah nya: Rp ………………………………

25. Berapakah pengeluaran tahunan perusahaan Anda, sejak tahun 1998-2013 (dalam rupiah), bias dengan memberikan tanga (✔) atau menuliskan jumlahnya pada table berikut? Apabila Anda tidak yakin, mohon ke pertanyaan no.7.

Tahun	< 5jt	5.1jt-10jt	10.1jt-25jt	25,1jt-50jt	50.1jt-100jt	101jt-250jt	251jt-500jt	501jt-1M	1,1M-2,5M	2,,51M-5M	>5M
1998											
1999											
2000											
2001											
2002											
2003											
2004											
2005											
2006											
2007											
2008											
2009											
2010											
2011											
2012											

2013											

26. Berapakah rata-rata kenaikan atau penurunan pengeluaran perusahaan Anda dari tahun 1998-2014? Lewati pertanyaan ini jika Anda sudah menjawab pertanyaan no. 6.

    - Kurang dari (-10%)
    - (-10%) – (-5%)
    - (-5.01%) – (0%)
    - 0.01% -5%
    - 5.01% - 10%
    - 10.01% - 15%
    - 15.01% - 20%
    - Lebih dari 20%

27. Berapakah Investasi perusahaan Anda pada tahun 2014?

    - Kurang dari Rp 5 jt
    - Rp 5,1 jt – Rp 10 jt
    - Rp 10,1 jt – Rp 25 jt
    - Rp 25,1 jt – Rp 50 jt
    - Rp 50,1 jt – Rp 100 jt
    - Rp 100,1 jt – Rp 250 jt
    - Rp 250,1 jt – Rp 500 jt
    - Rp 500,1 jt – Rp 1 miliar
    - Rp 1,1 miliar – Rp 2,5 miliar
    - Rp 2,51 miliar – Rp 5 miliar
    - Lebih dari Rp 5 miliar

    Jika tidak keberatan, mohon disebutkan jumlah nya: Rp …………………………

28. Berapakah investasi tahunan perusahaan Anda, sejak tahun 1998-2013 (dalam rupiah), bias dengan memberikan tanga (✔) atau menuliskan jumlahnya pada table

berikut? Apabila Anda tidak yakin, mohon ke pertanyaan no.10.

Tahun	< 5jt	5.1jt-10jt	10.1jt-25jt	25,1jt-50jt	50.1jt-100jt	101jt-250jt	251jt-500jt	501jt-1M	1,1M-2,5M	2,,51M-5M	>5M
1998											
1999											
2000											
2001											
2002											
2003											
2004											
2005											
2006											
2007											
2008											
2009											
2010											
2011											
2012											
2013											

29. Berapakah rata-rata kenaikan atau penurunan investasi perusahaan Anda dari tahun 1998-2014? Lewati pertanyaan ini jika Anda sudah menjawab pertanyaan no. 9.

    ☐ Kurang dari (-10%)

    ☐ (-10%) – (-5%)

    ☐ (-5.01%) – (0%)

    ☐ 0.01% -5%

    ☐ 5.01% - 10%

    ☐ 10.01% - 15%

    ☐ 15.01% - 20%

    ☐ Lebih dari 20%

30. Berapakah total pengeluaran untuk biaya ICT (termasuk hardware dan software) perusahaan Anda selama tahun 2014 (dalam rupiah)?

    ☐ Kurang dari Rp 5 jt

    ☐ Rp 5,1 jt – Rp 10 jt

    ☐ Rp 10,1 jt – Rp 25 jt

    ☐ Rp 25,1 jt – Rp 50 jt

    ☐ Rp 50,1 jt – Rp 100 jt

    ☐ Rp 100,1 jt – Rp 250 jt

    ☐ Rp 250,1 jt – Rp 500 jt

    ☐ Rp 500,1 jt – Rp 1 miliar

    ☐ Rp 1,1 miliar – Rp 2,5 miliar

    ☐ Rp 2,51 miliar – Rp 5 miliar

    ☐ Lebih dari Rp 5 miliar

    Jika tidak keberatan, mohon disebutkan jumlah nya: Rp ……………………………

31. Berapakah pengeluaran untuk biaya ICT (termasuk hardware dan software) tahunan perusahaan Anda, sejak tahun 1998-2013 (dalam rupiah), bias dengan memberikan tanga (✔) atau menuliskan jumlahnya pada table berikut? Apabila Anda tidak yakin, mohon ke pertanyaan no.13.

Tahun	< 5jt	5.1jt-10jt	10.1jt-25jt	25,1jt-50jt	50.1jt-100jt	101jt-250jt	251jt-500jt	501jt-1M	1,1M-2,5M	2,,51M-5M	>5M
1998											
1999											
2000											
2001											
2002											
2003											
2004											
2005											
2006											
2007											
2008											
2009											
2010											
2011											
2012											
2013											

32. Berapakah rata-rata kenaikan atau penurunan pengeluaran untuk biaya ICT (termasuk hardware dan software) perusahaan Anda dari tahun 1998-2014? Lewati pertanyaan ini jika Anda sudah menjawab pertanyaan no. 12.

- Kurang dari (-10%)
- (-10%) – (-5%)
- (-5.01%) – (0%)
- 0.01% -5%
- 5.01% - 10%
- 10.01% - 15%
- 15.01% - 20%
- Lebih dari 20%

33. Berapakah total pengeluaran untuk biaya ICT services (lihat definisi ICT services pada lampiran) perusahaan Anda selama tahun 2014 (dalam rupiah)?

- Kurang dari Rp 1 jt
- Rp 1 jt- Rp 5 jt
- Rp 5,1 jt – Rp 10 jt
- Rp 10,1 jt – Rp 25 jt
- Rp 25,1 jt – Rp 50 jt
- Rp 50,1 jt – Rp 100 jt
- Rp 100,1 jt – Rp 250 jt
- Rp 250,1 jt – Rp 500 jt
- Rp 500,1 jt – Rp 1 miliar
- Rp 1,1 miliar – Rp 2,5 miliar
- Rp 2,51 miliar – Rp 5 miliar
- Lebih dari Rp 5 miliar

Jika tidak keberatan, mohon disebutkan jumlah nya: Rp …………………………….

34. Berapakah pengeluaran untuk biaya ICT services (lihat definisi ICT services pada lampiran) tahunan perusahaan Anda, sejak tahun 1998-2013 (dalam rupiah), bias dengan memberikan tanga (✔) atau menuliskan jumlahnya pada table berikut? Apabila Anda tidak yakin, mohon ke pertanyaan no.16.

Tahun	< 1 jt	1jt – 5jt	5.1jt-10jt	10.1jt-25jt	25,1jt-50jt	50.1jt-100jt	101jt-250jt	251jt-500jt	501jt-1M	1,1M-2,5M	2,,51M-5M	>5M

1998												
1999												
2000												
2001												
2002												
2003												
2004												
2005												
2006												
2007												
2008												
2009												
2010												
2011												
2012												
2013												

35. Berapakah rata-rata kenaikan atau penurunan pengeluaran untuk biaya ICT services perusahaan Anda dari tahun 1998-2014? Lewati pertanyaan ini jika Anda sudah menjawab pertanyaan no. 15.

- Kurang dari (-10%)
- (-10%) – (-5%)
- (-5.01%) – (0%)
- 0.01% -5%
- 5.01% - 10%
- 10.01% - 15%
- 15.01% - 20%
- Lebih dari 20%

36. Bagaimana komposisi biaya ICT services perusahaan Anda pada tahun 2014?

ICT service	Komposisi(%)
Telepon tetap	
Telepon seluler	
Internet	
Cloud Computing	
On site Managed services	
Off site Managed services	

37. Apakah ada perubahan komposisi biaya ICT services Perusahaan Anda sejak tahun 1998?

- Ya, Ya, mohon dapat diisi table berikut ini

Tahun	Telepon tetap	Telepon seluler	Internet	Cloud Computing	On site Managed services	Off site Managed services
1998						
1999						

2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						
2013						

 Tidak

38. Berapakah biaya SDM perusahaan Anda selama tahun 2014 (dalam rupiah)?

 Kurang dari Rp 5 jt

- Rp 5,1 jt – Rp 10 jt
- Rp 10,1 jt – Rp 25 jt
- Rp 25,1 jt – Rp 50 jt
- Rp 50,1 jt – Rp 100 jt
- Rp 100,1 jt – Rp 250 jt
- Rp 250,1 jt – Rp 500 jt
- Rp 500,1 jt – Rp 1 miliar
- Rp 1,1 miliar – Rp 2,5 miliar
- Rp 2,51 miliar – Rp 5 miliar
- Lebih dari Rp 5 miliar

Jika tidak keberatan, mohon disebutkan jumlah nya: Rp ………………………………

39. Berapakah biaya SDM tahunan perusahaan Anda, sejak tahun 1998-2013 (dalam rupiah), bias dengan memberikan tanga (✔) atau menuliskan jumlahnya pada table berikut? Apabila Anda tidak yakin, mohon ke pertanyaan no.19.

Tahun	< 5jt	5.1jt-10jt	10.1jt-25jt	25,1jt-50jt	50.1jt-100jt	101jt-250jt	251jt-500jt	501jt-1M	1,1M-2,5M	2,,51M-5M	>5M
1998											
1999											
2000											
2001											
2002											
2003											
2004											
2005											
2006											

2007											
2008											
2009											
2010											
2011											
2012											
2013											

40. Berapakah rata-rata kenaikan atau penurunan biaya SDM perusahaan Anda dari tahun 1998-2014? Lewati pertanyaan ini jika Anda sudah menjawab pertanyaan no. 18.

 □ Kurang dari (-10%)

 □ (-10%) – (-5%)

 □ (-5.01%) – (0%)

 □ 0.01% -5%

 □ 5.01% - 10%

 □ 10.01% - 15%

 □ 15.01% - 20%

 □ Lebih dari 20%

E.2 : Proyeksi Keuangan (2015-2020)

7. Apakah pendapatan (revenue) perusahaan Anda diproyeksikan naik atau turun dalam waktu 5 tahun mendatang?

 Ya, Mohon dapat mengisi table berikut dengan tanda (+) menunjukkan kenaikan atau tanga (-) menunjukkan penurunan. Jika tidak keberatan, dapat diisikan angka tepatnya.

Year	< 1%	1-5%	5-10%	10-15%	15-20%	20-25%	25-30%	>30%
2015								
2016								
2017								
2018								
2019								
2020								

 Tidak (sama saja dengan tahun ini)

 Tidak yakin

8. Apakah pengeluaran perusahaan Anda diproyeksikan naik atau turun dalam waktu 5 tahun mendatang?

 Ya, Mohon dapat mengisi table berikut dengan tanda (+) menunjukkan kenaikan atau tanga (-) menunjukkan penurunan. Jika tidak keberatan, dapat diisikan angka tepatnya.

Year	< 1%	1-5%	5-10%	10-15%	15-20%	20-25%	25-30%	>30%
2015								
2016								

2017								
2018								
2019								
2020								

- Tidak (sama saja dengan tahun ini)
- Tidak yakin

9. Apakah investasi perusahaan Anda diproyeksikan naik atau turun dalam waktu 5 tahun mendatang?

   - Ya, Mohon dapat mengisi table berikut dengan tanda (+) menunjukkan kenaikan atau tanga (-) menunjukkan penurunan. Jika tidak keberatan, dapat diisikan angka tepatnya.

Year	< 1%	1-5%	5-10%	10-15%	15-20%	20-25%	25-30%	>30%
2015								
2016								
2017								
2018								
2019								
2020								

- Tidak (sama saja dengan tahun ini)

□ Tidak yakin

10. Apakah biaya total ICT perusahaan Anda diproyeksikan naik atau turun dalam waktu 5 tahun mendatang?

    □ Ya, Mohon dapat mengisi table berikut dengan tanda (+) menunjukkan kenaikan atau tanga (-) menunjukkan penurunan. Jika tidak keberatan, dapat diisikan angka tepatnya.

Year	< 1%	1-5%	5-10%	10-15%	15-20%	20-25%	25-30%	>30%
2015								
2016								
2017								
2018								
2019								
2020								

    □ Tidak (sama saja dengan tahun ini)

    □ Tidak yakin

11. Apakah biaya ICT services perusahaan Anda diproyeksikan naik atau turun dalam waktu 5 tahun mendatang?

    □ Ya, Mohon dapat mengisi table berikut dengan tanda (+) menunjukkan kenaikan atau tanga (-) menunjukkan penurunan. Jika tidak keberatan, dapat diisikan angka tepatnya.

Year	< 1%	1-5%	5-10%	10-15%	15-20%	20-25%	25-30%	>30%
2015								
2016								

2017								
2018								
2019								
2020								

- Tidak (sama saja dengan tahun ini)
- Tidak yakin

12. Apakah biaya SDM perusahaan Anda diproyeksikan naik atau turun dalam waktu 5 tahun mendatang?

- Ya, Mohon dapat mengisi table berikut dengan tanda (+) menunjukkan kenaikan atau tanga (-) menunjukkan penurunan. Jika tidak keberatan, dapat diisikan angka tepatnya.

Year	< 1%	1-5%	5-10%	10-15%	15-20%	20-25%	25-30%	>30%
2015								
2016								
2017								
2018								
2019								
2020								

- Tidak (sama saja dengan tahun ini)
- Tidak yakin

Section F: SDM (Sumber Daya Manusia)

F.1 Data historis SDM (1998-2014)

14. Berapakah total jumlah karyawan Perusahaan Anda di tahun 2014?

- ☐ Kurang dari 2
- ☐ 2 - 5
- ☐ 6 - 10
- ☐ 11 -50
- ☐ 51 - 100
- ☐ 101 - 200
- ☐ 201 - 300
- ☐ 301 - 400
- ☐ 401 - 500
- ☐ 501 - 600
- ☐ 601 - 700
- ☐ 701 - 800
- ☐ 801 – 900
- ☐ 900 - 1000
- ☐ Lebih dari 1000

Jika tidak keberatan, mohon disebutkan jumlah nya: ………………………………….

15. Berapakah jumlah SDM perushan Anda sejak tahun 1998? Jika Anda tidak yakin, silakan langsung ke pertanayaan no.3.

Jawaban dapat diberikan dengan tanda (√) atau menuliskan jumlahnya.di kolom dengan range yg sesuai.

Tahun	< 2	2 - 5	6- 10	11- 50	51- 100	101- 200	201- 300	301- 400	401- 500	501- 600	601- 700	701- 800	801- 900	901- 1000	>1000
1998															

1999															
2000															
2001															
2002															
2003															
2004															
2005															
2006															
2007															
2008															
2009															
2010															
2011															
2012															
2013															
2014															

16. Berpakah rata-rata pertumbuhan SDM perusahaan ANda sejak tahun 1998 sampai 2014? Silakan skip pertanyaan ini jika Anda sudah menjawab pertanyaan no.2

☐ Less than (-10%)

☐ (-10%) – (-5%)

☐ (-5.01%) – (0%)

☐ 0.01% -5%

☐ 5.01% - 10%

☐ 10.01% - 15%

☐ 15.01% - 20%

☐ Lebih dari 20%

17. Apakah karyawan di perusahaan Ada bekerja 8 jm per hari?

☐ Ya

☐ Tidak, ……… jam

18. Apakah karyawan di perusahaan Ada bekerja 5 hari dalam seminggu?

☐ Ya

☐ Tidak, …….. hari

19. Apakah ada jam lembur bagi karyawan di perusahaan Anda?

☐ Ya, rata-rata ……….. jam per minggu.

☐ Tidak

20. Apakah karyawan bekerja dengan jumlah rata-ratajeam kerja dan lembur yang sama sejak tahun 1998?

☐ Ya

☐ Tidak, jam kerja dan lembur sejak 1998 adalah sebagai berikut:

Tahun	**Jam kerja/hari**			**Hari kerja/minggu**			**Jam lembur per minggu**		
	<8jam	**8jam**	**>8jam**	**<5hari**	**5hari**	**>5hari**	**<20jam**	**20jam**	**>20jam**
1998									
1999									
2000									
2001									
2002									

2003									
2004									
2005									
2006									
2007									
2008									
2009									
2010									
2011									
2012									
2013									

21. Bagaimanakah komposisi umur SDM perusahaan Anda di tahun 2014?

 < 30 tahun: ……..orang atau ……… %

 31-40 tahun: ……..orang atau ……… %

 41-50 tahun: ……..orang atau ……… %

 > 50 tahun: ……..orang atau ……… %

22. Apakah komposisi tersebut berubah sejak tahun 1998?

 Ya, komposisi SDM sejak tahun 1998 adalah sebagai berikut:

Tahun	Komposisi Umur SDM dalam % atau jumlah orang			
	<30 Tahun	31-40 tahun	41-50 tahun	50 tahun
1998				
1999				

2000				
2001				
2002				
2003				
2004				
2005				
2006				
2007				
2008				
2009				
2010				
2011				
2012				
2013				

- No

23. Bagaimanakah komposisi SDM berdasarkan pendidikan tertinggi?

- Lebih rendah dari SMA: ……………… orang atau ………………%
- SMA: ……………… orang atau ………………%
- D1: ……………… orang atau ………………%

- D2: ……………… orang atau ………………%
- D3: ……………… orang atau ………………%
- S1: ……………… orang atau ………………%
- S2: ……………… orang atau ………………%
- S3: ……………… orang atau ………………%

24. Akahah komposisi berdasarkan pendidikan tertinggibtersebut berubah sejak tahun 1998?

    - Ya, komposisi berdasar pendidikan tertinggi adalah sbb: (dalam jml orang atau %)

Tahun	<SMA	SMA	D1	D2	D3	S1	S2	S3
1998								
1999								
2000								
2001								
2002								
2003								
2004								
2005								
2006								
2007								
2008								
2009								
2010								
2011								
2012								

2013								
2014								

25. Berpakah jumlah SDM dalam posisi berikut ini di tahun 2014?

    - Staff: ……………… orang atau ………………%
    - Supervisor atau manager: ……………… orang atau ………………%
    - Senior manager: ……………… orang atau ………………%
    - Direktur: ……………… orang atau ………………%

26. Bagaimanakah tingkat penguasaan ICT mereka?

    - Rendah: ……………… orang atau ………………%
    - Biasa: ……………… orang atau ………………%
    - Ahli: ……………… orang atau ………………%

F.2 Data SDM masa mendatang (2015-2020)

5. Apakah perusahaan Anda memiliki rencana untuk merubah komposisi umur SDM dalam 5 tahun mendatang?

    - Ya, mohon dapat diisi table di bawah ini

Tahun	Komposisi umur SDM dalam % atau jumlah orang			
	<30 tahun	31-40 tahun	41-50 ahun	>50 tahun
2015				
2016				
2017				
2018				
2019				

2020				

 Tidak

6. Apakah Perusahaan Anda memiliki rencana untuk menambah atau mengurangi jumlah karyawan dalam 5 tahun mendatang?

    Ya, mohon dapat diisi table di bawah ini dengan tanda (+) untuk menunjukkan penambahan atau (-) untuk pengurangan, atau menuliskan jumlah orang di kolom yang sesuai.

Tahun	0	0-1	2-5	6-10	11-25	26-50	51-100	101-200	201-500	>500
2015										
2016										
2017										
2018										
2019										
2020										

    No

7. Apakah akan ada perubahan jam kerja per hari, jumlah hari kerja per minggu dan jam lebur dalam kurun 5 tahun kedepan?

    Ya, mohon dapat diisi table berikut ini dengan tanda (+) untuk menunjukkan penambahan atau (-) untuk pengurangan, atau menuliskan jumlah orang di kolom yang sesuai.

Tahun	**Jam kerja/hari**			**Hari kerja/minggu**			**Jam lembur per minggu**		
	1	**2**	**3**	**1**	**2**	**3**	**1-2**	**3-4**	**5**
2015									

2016								
2017								
2018								
2019								
2020								

- ☐ Tidak
- ☐ Tidak tahu

--selesai---